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STACK

MIL08A

DESIGN & BUILD EMPLOYER REQUIREMENTS

REVISIONS

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CONTENTS

1.0 INTRODUCTION 11
1.1 Project Introduction 11
1.2 Document Introduction 11
1.3 The Site 12
1.4 The Project Scope 13
1.5 Phasing of Works 16
1.6 Temporary Services to Fallow Areas 17
1.7 Off-Site Manufacturing 17
1.8 Extent of Works 18
1.8.1 Introduction 18
1.8.2 General Requirements 19
1.8.3 Overview 19
1.8.4 Building Services Works Activities: 19
1.8.5 General 20
1.8.6 Electrical Services 21
1.8.7 Mechanical Services 22
1.8.8 Fire Services 23
1.8.9 Public Health 23
1.8.10 Communications: 23
1.8.11 Security: 23
1.8.12 Automation, Control and Monitoring: 24
1.8.13 Vertical Transportation: 24
1.8.14 Building Works in Connection: 24
1.9 Energy Efficiency 25
1.10 Contractor Design Responsibility 25
1.11 Testing, Commissioning and Setting to Work 28
1.11.1 General 28
1.11.2 Method statements 29
1.11.3 Factory testing 29
1.11.4 Site testing 29
1.11.5 Commissioning 29
1.11.6 Commissioning records 30

2.0 EMPLOYER'S REQUIREMENTS 30
2.1 General Requirements 30
2.2 Scope 30

3.0 PERMITTING 31

4.0 ARCHITECTURE 32
4.0 Description of the intervention plan 32
4.1 Data Center Buildings 33
4.2 Buildings Composition 34
4.3 Physical security 35
4.4 Functional areas 36
4.4.2 Data Hall 37
4.4.3 MEP Gallery and Technical Corridor 37
4.4.4 External technical area "Gantry" 38
4.4.5 Offices 38
4.4.6 Toilet Facilities 39
4.4.7 Storages 39
4.4.8 Technical rooms 40
4.5 Overcoming Architectural Barriers 40

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4.6 Construction types ... 41
4.6.2 Vertical Stratigraphies ... 41
4.6.3 Doors and Windows ... 42
4.6.4 Horizontal Stratigraphies ... 44
4.6.5 Ceilings ... 45

5.0 STRUCTURE ... 46
5.1 GENERAL INFORMATION ... 46
5.2 REFERENCE STANDARDS ... 47
5.3 MATERIAL PROPERTIES ... 48
5.4 DESIGN LOADS ... 49
5.4.1 General information ... 49
5.4.2 Vertical load ... 49
5.4.3 Snow ... 50
5.4.4 Wind load ... 51
5.4.5 Fire resistance ... 52
5.4.6 Thermal variations ... 52
5.4.7 Seismic action ... 52
5.5 STRUCTURAL LAYOUT AND LATERAL RESISTING SYSTEM ... 54
5.6 STRUCTURAL REQUIREMENTS FOR MEP ... 56

6.0 CIVIL WORKS AND INCOMING UTILITIES AND SITE SERVICES ... 56
6.1 General ... 56
6.2 Potable and non-potable Water ... 58
6.3 Wastewater and Industrial Water Drainage ... 58
6.4 Rainwater Drainage ... 59
6.4.1 Roof Rainwater Drainage ... 59
6.4.2 Glycol containment ... 60
6.4.3 Oilwater drainage ... 60
6.4.4 Diesel containment ... 60
6.4.5 Lamination tanks ... 61
6.5 Sprinkler and fire hydrant systems ... 61
6.6 Telecommunications ... 61
6.6.1 Fibre Service General ... 61
6.6.2 Fibre Service Specific ... 61
6.7 Gas Supply ... 62
6.8 Electrical Supply ... 62

7.0 EXTERNAL ELECTRICAL SERVICES ... 63
7.1 General ... 63
7.2 External Lighting ... 63
7.3 EXTERNAL SECURITY ... 64
7.3.1 Requirement ... 64
7.3.2 External CCTV ... 64
7.3.3 External Access Control ... 65
7.4 External Power ... 65
7.4.1 Requirements ... 65
7.4.2 Surface Water Pumps ... 66
7.4.3 Security Services ... 66

8.0 FIRE & LIFE SAFETY STRATEGY ... 66

9.0 MEP SERVICES DESIGN CRITERIA ... 68
9.1 General ... 68
9.2 Drainage ... 69
9.2.1 Codes and Standards ... 69
Reference ... 69
9.2.2 Design Criteria ... 69

9.2.3 Foul & Waste 70
9.3 Water Supply 70
9.3.1 Codes and Standards 70
9.3.2 Design Criteria 70
9.3.3 Cold Water Supply 71
9.3.4 Hot Water Supply 71
9.4 Fuel System 71
9.4.1 Codes and Standards 71
9.4.2 Design Criteria 72
9.5 Cooling 72
9.5.1 Codes and Standards 72
9.5.2 Ambient Design Conditions 72
9.5.3 Indoor Design Conditions 74
9.5.4 Chilled Water Pipework Sizing 75
9.6 Ventilation System 75
9.6.1 Codes and Standards 75
9.6.2 Data Hall Pressurization 75
9.6.3 Admin Building Ventilation 76
9.6.4 Standalone Spaces Ventilation 77
9.6.5 Filtration Design Criteria 77
9.6.6 Equipment Resilience 77
9.6.7 Smoke Control 77
9.7 Fire Protection 78
9.7.1 Codes and Standards 78
9.7.2 Design Criteria 78
9.8 Noise Criteria 81
9.9 Mechanical Equipment Resilience 81
9.10 Lighting 81
9.11 Electrical Infrastructure Resilience 82
9.12 OFCI Equipment 82

10.0 ELECTRICAL SYSTEMS 83
10.2 MV Infrastructure 83
10.2.1 Incoming Utility Supply 83
10.2.2 MV Distribution 83
10.2.3 MV Switchgear 84
10.2.4 132 kV / 22 kV Transformers 84
10.2.5 Critical Power Modules Transformers 84
10.2.6 Control and Monitoring of MV Infrastructure 85
10.3 PV Infrastructure 85
10.3.1 PV Infrastructure Installation 85
10.4 LV Infrastructure 85
10.4.1 Critical LV Distribution 85
10.4.2 LV Switchgear 86
10.4.3 Uninterruptable Power Supplies (UPS) 87
10.4.4 IT UPS 87
10.4.5 Landlord's UPS 88
10.4.6 UPS Status Indication 89
10.4.7 UPS Batteries 89
10.4.8 Final Circuit Distribution Boards 89
10.4.9 Cabling, Cable Management and Support Systems 90
10.4.10 Busbar Trunking Systems 92
10.5 On-Site Generation 93
10.5.1 General 93
10.5.2 Generator Containers 94
10.5.3 Bulk Fuel Storage 94

10.6 Earthing 95
10.6.1 Main Earthing 95
10.6.2 Circuit Protective Conductors 96
10.6.3 Bonding 96
10.7 Lightning Protection 96
10.8 Small and Fixed Power 98
10.8.1 Requirement 98
10.8.2 General Power Outlets 98
10.8.3 Critical Power 99
10.8.4 Mechanical and Public Health Power 99
10.8.5 Fan Wall Units(FWU) 100
10.8.6 Cooling Distribution Units (CDUs) 100
10.8.7 Chillers and Primary Pumps 100
10.8.8 Water Saving Solenoid Valves 100
10.8.9 Trace Heating 101
10.9 Lighting 101
10.9.1 General 101
10.9.2 Design 102
10.9.3 Lighting Control 102
10.10 Emergency Lighting 103
10.10.1 Requirements 103
10.10.2 Emergency lighting function 104
10.11 Life Safety 105
10.11.1 Requirements 105
10.12 Facilities for the Disabled 106
10.12.1 Requirement 106
10.12.2 Disabled Refuge Alarm 106
10.12.3 Disabled Persons Alarm 106
10.12.4 Induction Loops 106

11.0 FIRE DETECTION 106
11.1 Requirement 106
11.1.1 Main Equipment Room(s) location: 107
11.2 Fire Detection and Alarm Systems 107
11.2.1 Data Halls / MMRs 109
11.2.2 Electrical Switch rooms 109
11.2.3 HV Switch rooms / Generator MV switch rooms 109
11.2.4 General areas 109
11.2.5 External areas 109
11.3 Fire Alarm Interfaces 109
11.4 Fire Systems Cause and Effect (C&E) Overview 110
11.5 Emergency Power Off – EPO Strategy 111

12.0 COMMUNICATIONS 112
12.1 IT / Telecoms 112
12.2 Network Providers 112
12.3 Telco Rooms – MMR 113
12.4 Cabling and Containment Provision to Data Halls 113
12.5 Tenant Installation 113

13.0 ENGINEERING SITE COMMUNICATIONS 113
13.1 OVERVIEW 113
13.1.1 Overarching Philosophy 114
13.1.2 Communication Outside Plan (OSP) 114
13.1.3 Communication Containment (Tenant) Strategy: 115
13.1.4 Network Design 115
13.1.5 Network Architecture 115

13.1.6 Network Security Features 116
13.1.7 Horizontal Cabling System 117
13.1.8 Backbone Cabling 117
13.1.9 RJ45 Face Plate 117
13.1.10 Fibre Optic Patch Panel (FOPP) 118
13.1.11 Wi-Fi System 118
13.1.12 Wireless Access Point: 120
13.1.13 IP Telephony System 122
13.1.14 Core Switch/Distribution Switches 122
13.1.15 Access Switches 123
13.1.16 Switch Architecture 124
13.1.17 Server farm Switch 127
13.1.18 Firewall 127
13.2 Tenant BACS Integration 128
13.3 Employer's Systems of Communication 129

14.0 SECURITY 130
14.1 General 130
14.2 Access Control 130
14.3 Controllers and Hardware 134
14.4 Software – ACS 135
14.5 Smart Card Reader 136
14.6 Enrolment and Validation reader. 137
14.7 Intercomm 137
14.8 Fire Alarm Integration 137
14.9 CCTV Integration 138
14.10 SOC Room 138
14.11 Keylocker 139
14.12 Internal Closed- Circuit Television (CCTV) 139
14.12.1 General 139
14.12.2 Cameras 141
14.12.3 Camera Configuration. 142
14.12.4 Video Streaming. 143
14.12.5 Video Management System 143

15.0 LIFTS 144
15.1 General 144
15.2 Passenger Lift 145
15.3 Goods Lift 145

16.0 MECHANICAL AND PUBLIC HEALTH SERVICES SYSTEM OVERVIEW 145

17.0 MECHANICAL SERVICES DESCRIPTION 146
17.1 Cooling Systems 146
17.1.1 Chilled Water System Overview 146
17.1.2 Dat Hall Cooling Overview 147
17.1.3 LV/MV Power Modules Cooling 149
17.1.4 MMR Cooling 149
17.1.5 Admin building Cooling & Heating Systems 149
17.1.6 Heating & Cooling – shell and core 151
17.1.7 Air-Cooled Chiller Chilled Water Circuit 151
17.2 Ventilation Systems 151
17.2.1 Main Supply and Extract Ventilation 151
17.2.2 External Plant Room Ventilation 152
17.2.3 Extract Fans 152
17.2.4 Smoke Ventilation System 152
17.2.5 Natural Smoke Ventilation 153
17.2.6 Generator containers ventilation 153

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17.2.7 Humidification 154
17.2.8 Lift Shaft Ventilation 154
17.2.9 Admin Building Ventilation 154
17.2.10 Occupied Areas Supply and Extract Ventilation 154
17.2.11 Toilet and Shower Areas Ventilation 155
17.2.12 Loading Bay Ventilation 155
17.2.13 Mechanical Ventilation – Shell and Core 156
17.2.14 Ductwork Distribution System 156
17.3 Condensate Pipework 156
17.4 External Plant Colours 156
17.5 Pressure Independent Control Valves 157
17.6 PUE Calculations 157

18.0 PUBLIC HEALTH SERVICES DESCRIPTION 157
18.1 Water Services 157
18.1.1 Water Supply 157
18.1.2 Water Treatment System 158
18.1.3 Washdown Bib-taps 158
18.1.4 Fire tank 158
18.1.5 Water Storage tanks 158
18.1.6 Cold water Workmanship 159
18.1.7 Hot water 159
18.2 Admin Building Water Services 160
18.2.1 General: 160
18.2.2 Domestic Cold Water 160
18.2.3 Domestic Hot Water 160
18.2.4 Water Services Pipework 161
18.3 Drainage Services 161
18.3.1 Foul Water Drainage 161
18.3.2 Condensate Drain 162
18.3.3 Rainwater Drainage 162
18.3.4 Mechanical Equipment Drainage 162
18.3.5 Admin Building Above Ground Drainage 163
18.3.6 Drainage Pipework 163
18.4 Foul Drainage Above Ground 164
18.4.1 Performance Criteria 164
18.4.2 Routes 164
18.4.3 Installation 164
18.4.4 Connections Between Pipes of Different Materials 165

19.0 FIRE SUPPRESSION SYSTEMS 166
19.1 Systems 166
19.1.1 Automatic Sprinkler Protection 166
19.1.2 Fire Hose Reels 166
19.2 General Requirements 167
19.2.1 Standards 167
19.2.2 Installation 167
19.2.3 Electrical Supplies 167
19.3 Automatic Sprinkler System 168
19.3.1 Overview 168
19.3.2 General Requirements 168
19.3.3 Welding 169
19.3.4 Valve Stations 169
19.3.5 Subsidiary Stop Valves 169
19.3.6 Sprinkler Pumps 169
19.3.7 Water storage tanks 169
19.3.8 Testing and Commissioning 169

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19.3.9 Certification 170
19.4 Fire Hose Reel System 170
19.4.1 Overview 170
19.4.2 General Requirements 171
19.4.3 Welding 171
19.4.4 Hose Reel Pumps 171
19.4.5 Water storage tanks 171
19.4.6 Testing and Commissioning 172
19.4.7 Certification 172
19.5 Fire Hydrants 173
19.5.1 Scope 173
19.5.2 Locations 173
19.5.3 Surface boxes 173
19.5.4 Water supply 173
19.5.5 Fire Pumps 173
19.5.6 Fire Hydrants 174
19.5.7 Resilience 174

20.0 CUSTOMER FITOUT 174

21.0 ACOUSTICS 175
21.2 External Noise Limits from Plant 176
21.2.1 The noise emitted from the development shall meet the noise limits imposed within the ~~SCIA~~ Noise Impact Assessment Report by Lombardini22 and Atmos Building Physics. 176
21.3 Chillers 177
21.4 Generators 177
21.5 Air Handling Units 177

22.0 PLANT REPLACEMENT STRATEGY 177
22.1 Overview 177
22.2 Large Items 179
22.3 Small to Medium Items 179
22.4 Special Considerations 180

23.0 CFD STUDY 180

24.0 BUILDING AUTOMATION & CONTROLS SYSTEM(BACS) 182
24.1 Sensor arrangement in Critical Spaces. 183
24.1.1 BACS Server Software 184
24.1.2 BACS Server Hardware & Operating System 185
24.1.3 Controller Software 185
24.1.4 BMS/EPMS Controller 185
24.1.5 BMS Standard Graphics Display 186
24.1.6 Cooling management System 187

25.0 LEAK DETECTION 187
25.1 Requirement 187
25.2 Sensing Cable 188
25.3 Leak detection Panel 189
25.4 Installation 189

26.0 TRACE HEATING 189
26.1 Requirement 189
26.2 Specialist Sub-Contractors 189
26.3 Freeze Protection to Exposed Mechanical Services 190

27.0 LOCAL STANDARDS 192
27.1 For general design criteria: 192
27.1.1 Reference UNI standards for heating and air conditioning systems. 196
27.1.2 Reference UNI standards for plumbing and sanitary systems. 203

27.1.3 Reference UNI standards for fire protection systems. 204

28.0 PRE-QUALIFIED SUPPLIERS AND MANUFACTURERS 206

APPENDIX A –PROJECT DOCUMENTS LIST 210

APPENDIX B – CUSTOMER SOQ MATRIX 211

APPENDIX C – STACK DESIGN DECISION TRACKER 213

APPENDIX D – STEER DEVIATION TRACKER 214

APPENDIX E – RIBA STAGE 4 REQUIRED DELIVERABLES 215

217

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1.0 INTRODUCTION

1.1 Project Introduction

01 Black & White Engineering (B&W) have been appointed by STACK EMEA (STACK) to provide design and consultancy services to RIBA Stage 3, and Employer Requirements for design and build of a prospective data centre near Milan, Italy .

02 The Project has been developed specifically for Stack EMEA (STACK).

03 The project is in in Siziano Borgo Casatico , outside Milan, Italy.

04 The project name is known as MIL08A.

05 The project is a new build shell and technical fitout.

06 The Employer's design team members can be found in the main contract conditions and preliminaries, and are summarised below:

Role	Company
Lead Design Consultancy	Black & White Engineering (BWE)
MEP Engineering	Black & White Engineering (BWE)
Architecture	Lombardini 22 (L22)
Civil	Lombardini 22 (L22)
Structure	SPS
Planning & Permitting Lead	Lombardini 22 (L22)
Fie & Life Safety Consultancy	Lombardini 22 (L22)
Acoustics	Lombardini 22 (L22)
Localization	Lombardini 22 (L22)
BIM Management	ARC:BIM

07 This specification describes the engineering services and permitting, including civil , structure , architecture, electrical, controls, mechanical, public health, security, fire, acoustics and communications.

08 This specification relates to the requirements to establish the main building construction in full (24 MW_{IT}).

1.2 Document Introduction

01 This document has been written to detail the particular project requirements for the project design, installation and testing for the works.

02 This document shall be read in conjunction with the main contract conditions, project preliminaries and engineering preliminaries document, and the following but not limited to:

1. Project documents outlined in Appendix A.
2. Stack's OFCI Demarcation Matrix
3. Stack's Customer Interface and Compliance requirements
4. Stack's BIM standards and BIM requirements by ARC:BIM
5. Stack's Testing and Commissioning Specifications
6. Solutions engineering Employer Requirements – Design Deliverables Index
7. STACK IT Infrastructure design Guide.

03 The project is a design and build delivery carried out under a FIDIC form of contract. The Contractor shall review all associated documents in particular the Employers Requirement documents which includes the technical design provided by the Employers technical team.

04 A list of applicable design project documents i.e. drawings, standard specifications, equipment schedules and data sheets are provided within Appendix A. It should be noted that the general specifications outline the minimum expected requirement, but the information contained within the particular information (for example, this specification) are authoritative over standard specifications.

1.3 The Site

01 The MIL08A site is located to the south east of Milan part of Siziano Borgo Casatico site approx. 13km far from Milan Linate Airport.

02 The site location is in an industrial area surrounded by agricultural land, and a residential area to the south.

03 The project campus accommodates 2 data centre buildings for Stack MIL08A & B.

04 MIL08A being a new data centre building with attached office support block.

05 MIL08B is being designed by a separate consultant team and is not covered in this document.

06 Since the MIL08A project is located within a data centre campus, the Contractor will need to ensure coordination and interface between phases/buildings to avoid any impact on the operational site.

07 The site is crossed by public sewer, two aerial power lines, and an irrigation canal. Diverting these services is a necessary precondition for both MIL08A and MIL08B projects. Service diversion is not covered in this document.

08 Access to the site will be from a new public road around the site, the construction of which is not covered in this document.

09 This site is not located in areas mapped as a liquefaction zone.

10 This site is not located in areas mapped with flood risk of 300, 500 years.

11 An Implementation Plan ("*Piano Attuativo*") for the transformation of the entire site (MIL08A + MIL08B + external service areas + new public road) has already been approved by the Municipality of Vignate.

12 Two different Building Permits will have to be submitted for MIL08A and MIL08B, consistent with the indications of the "*Piano Attuativo*". The Building Permit referred to MIL08B is handled by a separate consultant team and is not covered in this document.

1.4 The Project Scope

01 The client is a colocation data centre provider and this project is to establish a capacity within Italy for that client. The initial requirement for the site is to develop a facility capable of delivering a minimum critical load for server deployment of 20 MWIT.

02 The following table summarises the building key parameters :

Description	Criteria
No. of Storeys	One Storey DH Block + Two Storey Admin Block
Storage Area	Minimum (20MW*300SF/MW) + STACK Storage space
Office Area	Minimum (3000SF + 10MW*200SF/MW)+ STACK office space
IT Load	20 MW_{IT}
Estimated Power Connection Required	31.2 MVA
Prospective Peak PUE	1.53
Data Hall Capacity / Quantity	• 6 MW & 4MW/ DH • 2 x 6MW & 2 x 4MW DHS on ground
Data hall IT Density	500kW/row
IT Cabinet Configuration	Hot Aisle Containment
Data hall arrangement	24 racks per row 6MW DH = 12 rows per data hall 4 MW DH = 8 rows per data hall
Cold Isle Width	Minimum 1800mm
Hot Isle Width	Minimum 1520mm
Electrical Topology	6+1 Block Redundant UPS and Generators for the first 12 MW and 4+1 Block Redundant UPS and Generators for the last 8 MW, 5 to make 4 mechanical line ups per 20 MW
Cooling Topology	Air-cooled free cooling chillers at N+2 Fan wall units serving datahalls N+2 CDUs serving liquid cooled racks N+1 CRAH units in electrical rooms N+1
Tier Target	Not certified, but Concurrently Maintainable
Lift Design	At least two freight elevators with 5440kg load capacity Lift door clearance minimum 2.50m X 3.05m Lift car minimum 2.50m W x 3.05 m Deep

03 Although the building will not target Tier accreditation, engineering services shall adhere to 'concurrently maintainable' design principles and will allow continued operation under a single failure and permit maintenance to be undertaken without a reduction in service. As such, the site design components will generally be designed with a minimum level of critical component resilience to N+1.

04 The underlying aim of the design is to deliver as much flexibility and maximum utilisation of site space and resources available, whilst remaining within the limitations set out within the planning approval. As such, various allowances have been made to present a worst-case building size and profile. In some cases, the actual design shall be proved at a reduced proposal to that of the maximum.

05 The project comprises the development of a new data centre facility.

06 A resilient power and cooling infrastructure shall be provided to support the critical loads. UPS plant shall be located inside the building and configured as an isolated redundant system.

07 The project and the fit-out of the facility will be carried out in phases.

08 The scope of each phase will be as set out in the Employer's Requirements (ER) document.

09 This Project Specification document is for the works associated with MIL08A.

10 The engineering contract shall include, but not be limited to, the following areas;

1. External:
    a) Perimeter security;
    b) Electronic security;
    c) Carpark and external lighting;
    d) Connections to sub ground drainage;
    e) Incoming fibre and communications ducts;
    f) Incoming mains water for domestic services;
    g) Duct provision for secure vehicle access gate and gate house;
    h) Security and communications ducts;
    i) Fire suppression plant rooms;
    j) Sitewide utilities and plant rooms
2. Ground Floor
    a) Data Halls in their entirety;
    b) Electrical room;
    c) PV equipment room;
    d) MV distribution and associated enclosures/rooms;
    e) Loading bay;
    f) Build and storage areas;
    g) Goods lifts;

h) Passenger lifts;

i) Water tank rooms;

j) Facility Operation Centre (FOC);

k) Security Operation Centre (SOC);

l) Office and ancillary areas;

m) Client offices and board room;

n) Engineer stores and workshops;

o) Entrance Rooms (n.2) (POE);

p) Technical rooms

q) Storage rooms

r) Life safety systems;

s) Meet me rooms (MMR) (n.2);

t) Emergency management Center

u) WC and shower rooms;

v) Areas for future expansion;

w) Escape and access stair cores.

3. First Floor (Admin):

a) Office and ancillary areas;

b) Client offices and board rooms;

c) WC and shower rooms;

d) Areas for future expansion;

e) Escape and access stair cores.

f) Technical rooms

g) Storage rooms

4. Roof , Gantry and external plant areas:

a) Ground floor generator plant and standby generator systems;

b) Interface with HV/MV Substation

c) Power Modules for primary, reserve and house electrical systems (installed on ground floor);

d) Mechanical cooling plant and pumps installed on roof gantry;

e) Chilled water buffer vessels on roof gantry;

f) Ancillary rooms for chilled water systems on gantries;

g) External feedar;

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h) AHU systems for Data Halls and adjacent areas;

i) AHU systems for ground floor and first floor office accommodation;

j) Toilet supply and extract ventilation systems;

k) DX and VRF cooling systems for electrical rooms and MMR rooms;

l) VRF cooling systems for ground floor and first floor office accommodation;

m) Smoke ventilation plant.

1.5 Phasing of Works

01 The phasing of the works shall be as identified in the Employer's Requirements. The contractor shall provide all necessary services to negate any interruption to operational data centre facilities.

02 The contractor shall demonstrate within their design that allowance has been made within the design of the engineering systems and the site coordination that the later phases of deployment can be carried out with no disruption, and physically installed without the loss of resilience or service to the prior phases of the development and that they can operate within its SLA in a secure environment.

03 Where services, internal or external are designed to be extended these services and containment shall be designed with the required capacity and shall be terminated in an agreed manner where they are capable of being extended without the isolation and disruption of live services in the future.

04 Where customer's contract for staged power demand over the course of their occupation, the critical infrastructure serving their computer room space shall be installed in phases to match.

05 The building is divided into four (4) separate Data Halls (DH) with the deployment therefore phased on this basis. The below outlines the phasing:

Phase	No. Data Halls	Total IT load (kW)	Building / Zones
Phase 1	2	12,000	First two 6MW DHs & Admin Block
Phase 2	4	20,000	Third and fourth 4MW DHs

06 There's a requirement for the Contractor to procure and install sufficient plant to handover the DHs per phase.

07 There is a requirement for the Contractor to procure sufficiently efficient plant to achieve an IT load of 20 MW whilst not exceeding both the incoming supply capacity and the generator capacity serving the Computer Centres.

08 Proposed OFCI phasing summary is shown below, for further review and confirmation with Stack:

OFCI	Phase 1 (12MW)	Phase 2 (8MW)	Total (20 MW IT)
Primary Critical Power Modules	6	4	10
Reserve Critical Power Modules	1	1	2
Primary Mechanical Power Modules	4	1	5
Landlord Power Modules	0	0	0

OFCI	Phase 1 (12MW)	Phase 2 (8MW)	Total (20 MW IT)
2.4MW Generators	11	6	17
1.2MW Generators	0	0	0
Air Cooled Chillers	11	6	17
Fan Wall Units	28	20	48
CDUs	18	10	28

09 Design documents and calculations shall be required to demonstrate the Contractor's compliance.

10 The generator phasing and plant procurement shall align with the above phasing.

11 Reference shall be made to the phasing plans in the Project Documents for an overview of the areas within each phase.

1.6 Temporary Services to Fallow Areas

01 The contractor shall confirm fallow areas as part of his tender response within his contractor's proposals.

02 The contractor shall ensure that all escape routes enclosed for the purpose of circulation and escape have permanent final lighting, small power, ancillary services, lighting and emergency lighting installed. Areas outside defined and enclosed routes and rooms shall have a robust "temporary system" of lighting, fire alarm, detection and lighting together with self-contained emergency lighting to ensure that "fallow areas" can be accessed safely, can be maintained and can be viewed by potential tenants.

03 Where systems are provided for the permanent condition to protect the "fallow" areas, the installation shall comply with all regulations and technical standards and be certified by Building Control or the Employers approved representative. Allowances for temporary lighting and fire detection systems shall be allowed in fallow areas.

04 The removal of temporary electrical systems shall not involve isolation of house systems. Sacrificial isolation devices shall be installed that allows the removal of temporary services that are located such they do not obstruct the works of other phases.

05 The contractor shall allow a provision for temporary electric heating of fallow spaces for fabric protection should this be necessary.

1.7 Off-Site Manufacturing

01 The general contractor may propose to review updated positions of equipment, materials of construction, layouts, and size of the HV Switchrooms and Primary/Reserve Switchrooms, to suit offsite fabrication of modular rooms. Any changes proposed for off-site manufacturing shall meet all technical specifications described within the employers' requirements.

1.8 Extent of Works

1.8.1 Introduction

01 The extent of work covered by the specification and drawings includes the detailed design, site surveys, production of co-ordinated working drawings, technical submittals, procurement, supply, delivery, off- loading, positioning, storing, installation, setting to work, testing, commissioning, demonstration and handover of the services, associated controls and ancillary systems as described in the project documents.

02 The installation shall comprise all materials, labour, cartage, tools, plant, appliances, accessories and fixings necessary for the proper execution of the works, together with all minor and incidental works.

03 The following identifies the work to be undertaken by the Contractor. The listed items are not intended to limit or exclude any items required by the tender documents.

04 All quantities and sizes are indicative for information only and shall require verification under the Contractors' design and build remit.

05 The Contractor shall ensure toilet accommodation as required by Authorities for construction purposes is maintained in a sanitary condition at all times. Make all necessary arrangements for and pay all charges for sewer services.

06 The Contractor shall provide for temporary lighting and power for the Works, complete with switchboards, switchgear, meters, wiring, etc., and maintained, adapted, enlarged, extended as the need arises in accordance with the requirements of the power utility company and any other Authorities having jurisdiction over the Works.

07 An adequate level of light intensity shall be provided for performance of work in and about the Site.

08 The Contractor shall comply with relevant regulations and requirements, pay all fees and charges in connection with temporary lighting and power for the Works and offices, etc., pay for electricity consumed used including for testing of services and installations.

09 When it becomes imperative to remove temporary electrical installations, permanent circuits may be put into service, after inspection and testing, but in no circumstances shall the warranty period of any item of the electrical installation commence at a date earlier than the Date of Completion.

10 The Contractor shall provide and use its own lamps at all light outlets required for buildings and allied operations, excepting only for such period immediately prior to handover of buildings as the Employer's Representative may allow permanent lamps provided under the Sub-contract to be used for such purposes. Replacement of lamps or any fittings showing signs of damage shall be carried out at the expense of the Contractor, at the sole discretion of Employer's Representative.

11 The Contractor shall allow for temporary water service as necessary to carry out its obligations under the Contract. Extend service(s) and also augment the supply if so required, to provide metered supplies for the Works on Site and to make provision for raising water required as needed.

12 The Contractor shall return the meter(s), stop off service(s) to meet the Water Authority's requirements and remove from the Site the temporary installations and any associated material and equipment when no longer required.

13 Water drawn from the permanent installations for the Works for testing or other purpose during the Contract period to be metered and paid for by the Contractor.

14 The Contractor to pay for all water used for the work under the Contract at the Site and all costs and charges for the temporary installations, pipework, etc., meter hire.

15 Provide temporary fire protection in accordance with the requirements of the Authority having jurisdiction over the works.

1.8.2 General Requirements

01 The Contractor shall undertake the procurement, manufacture, installation, testing, commissioning, demonstration and disposal, where required, of all materials, equipment, plant and services as detailed within the project documents.

1.8.3 Overview

01 The Contractor shall deliver engineering services to provide complete and fully functioning systems to the building.

02 The Contractor shall furnish, deliver and install all materials, equipment and appurtenances required for a complete installation, including but not limited to pipes, ductwork, ventilation equipment, ancillaries, electrical distribution, containment and supports.

03 The engineering service works include the principal elements listed below:

1. Mechanical Services;
2. Electrical Services;
3. Public Health Services;
4. Building automation and control system.
5. Fire Services.
6. IT/Network services
7. Security services

1.8.4 Building Services Works Activities:

1. Production and issue of builders work drawings related to the M&PH services for Statutory approval;
2. Issue of technical submittals for all required equipment for Status A approval;
3. Issue of equipment fabrication and wiring diagrams for Status A approval;
4. Review and verification of all engineering systems, and design of specialist systems detailed in CDP section;
5. Design of all engineering systems, including specialist systems;
6. Obtain Statutory Approvals;
7. Manufacture;
8. Witness factory testing of selected equipment;
9. Supply and Delivery to Site;
10. Erect and Connect-up;
11. Test on Site;
12. Commission;

13. Performance Test;
14. Demonstration;
15. Provide operating and maintenance manuals and record information;
16. Train employer's staff;
17. Handover in full working order.

1.8.5 General

01 Detailed design for all building services including specialist design where applicable:

1. Compliance with local authority requirements;
2. Compliance with Building Permit conditions;
3. Provision of design deliverables;
4. CFD studies of external roof gantry at day final arrangement MIL04D. CFD studies shall consider wind conditions with all plant and equipment (generators, chillers, air handling units etc) operating at 100% duty. CFD studies shall be carried out for MIL04D and MIL04A,B,C combined.
5. CFD study for each unique Data Hall type for normal operations and failure operations under various scenarios to be agreed with the Client and their technical representative;
6. The outcome of the CFD studies shall form the basis of the plant and containment selections to meet the required output / performance criteria;
7. Noise impact assessment in accordance with The Building Permit and any local requirements and implementation of recommendations;
8. Plant replacement strategy;
9. Method statements and risk assessments;
10. Application for permits to work and system isolation requests;
11. Modifications to existing services;
12. Factory witness testing;
13. Coordination of installation works including the off-loading, positioning and on-site assembly of all main pre-ordered items of equipment (Power Modules, Transformers/RMU/MU, chillers and generators as required);
14. Installation of all power, controls and earthing cabling for the complete operation and functioning of the Power Modules, Generators, PV system, MV/LV transformers, MV and LV switchboards;
15. Labelling;
16. Temporary services as required;
17. Testing and commissioning (ASHRAE levels 1-5) for all equipment and systems (Coordinate with Client appointed Commissioning Manager);
18. Development, implementation and execution of an integrated system test (IST) to the Client's satisfaction;
19. Decommissioning, removal and disposal of any redundant or temporary equipment;

20. Record documentation;
21. Building logbook;
22. Staff training;
23. Seasonal commissioning checks and adjustments;
24. Miscellaneous works and equipment;
25. Handover including technical cleaning to EN 14644 Level 8;
26. Warranties;
27. Spares. Contractor to propose a spares list;
28. Defects liability.

1.8.6 Electrical Services

01 The electrical services installation is based on a block redundant system topology and shall comprise the provision of the following major items:

1. Existing N+N 22kV main MV switchboards located in the main substation;
2. Six (6) MV/LV primary critical power module substations supporting 2no. 6MW data halls IT load, critical cooling and ancillary loads (12 in total);
3. Four (4) MV/LV primary critical power module substations supporting 2no. 4MW data halls IT load, critical cooling and ancillary loads (8 in total);
4. Two (2) reserve critical substations per group of primary systems (2 in total);
5. Medium Voltage (MV) 22 kV rings, in an 2N formation, supporting the critical substations from N+N switchboards in the HV/LV substation;
6. LV containerised generators;
7. Multiple LV input switchboards;
8. PV system design and installation;
9. PV paralleling switchboards;
10. Mechanical UPS system;
11. Multiple LV UPS output switchboards;
12. MV cabling;
13. LV cabling;
14. Control and protection cabling;
15. Battery tripping units and distribution;
16. Distribution boards;
17. Power to mechanical, public health and fire services;
18. Power to security and communications services;

19. Power to ancillary services;
20. Small power distribution;
21. Lighting and lighting controls;
22. Access and emergency lighting via centrally battery and self-contained battery system;
23. Containment for all building services, security and communications;
24. Trace heating and associated panels and power supplies;
25. Earthing and bonding;
26. Lightning Protection;
27. Security services.

02 Refer to schedules for indicative ratings and quantities of main plant and equipment.

1.8.7 Mechanical Services

01 The mechanical services installation work shall comprise the provision of the following major items:

1. Air Cooled Chillers with free cooling and integrated VFD primary pumps;
2. Thermal Storage Buffer Vessels
3. FW (Fan Wall) units per Data hall;
4. CDUs (Cooling Distribution Units) per Data hall
5. CRAH units for MMR
6. Concurrently maintainable chilled water primary headers and secondary distribution;
7. Packaged ancillary plant rooms for chilled water plant, i.e. pressurisation units, pump control panels;
8. Interface and coordination with power modules vendor cooling and ventilation
9. Smoke extract and make up air systems
10. Fresh Air handling units for room pressurisation and humidity control to Data Halls;
11. Fresh Air handling units for heating, ventilation and cooling to offices and ancillary areas;
12. VRF for heating and cooling to offices and ancillary areas;
13. Distribution ductwork systems including volume control and fire dampers;
14. Air diffusers, grilles and perforated plates;
15. Acoustics weather louvres on all elevations of the service yards;
16. Weather louvres complete, where necessary, with bird mesh screens;
17. Thermal insulation;
18. Leak detection and drips trays;
19. Automatic controls;
20. BMS;

21. Acoustic treatment in compliance with Noise Emissions report.

1.8.8 Fire Services

01 The facility shall have fire suppressions and detections systems covering but not limited to:

1. Automatic fire detection and alarm system including interface with fire extinguishing systems, control systems, ventilation systems and BMS;
2. Multi aspirating smoke detection systems;
3. Air quality detection for fresh air intake;
4. Double interlock pre-action sprinkler systems;
5. Single interlock pre-action sprinkler systems;
6. Wet sprinkler systems
7. Fire hydrants and fire hose reels

1.8.9 Public Health

1. Domestic hot water heat pump system;
2. Point of use heaters for remote appliances;
3. Provision of drainage system to suit sanitary appliances.
4. Packaged drainage pumps;
5. Packaged domestic water booster pumps;
6. Water services;
7. Water treatment plant;
8. Condensate pumps;
9. Condensate and humidifiers drainage pipe work.

1.8.10 Communications:

1. Provision of a backbone operations technology (OT) fibre network as part of the ICT system;
2. Wireless access points throughout the building and external plant gantries, for systems monitoring purposes;
3. Mobile signal range extenders;
4. Supply, install and configuration of all active hardware, virtual LAN tags, firewalls and proxies;
5. Structured cabling system including voice and data cabling and all passive infrastructure for all systems on site that require IP connectivity;
6. All necessary high-level containment and power supplies, both internal and external;

1.8.11 Security:

1. Security provision for all critical areas.

2. External CCTV;
3. Access control;
4. Fully populated Security Operation Centre (SOC);
5. External plant room enclosures;
6. Primary and secondary supports for building services installation;
7. Open mesh grating to the gantry to suit the building services installation;
8. Provision of sleeving and fire stopping to all penetrations with an approved packing system, including future;
9. Louvre screen on gantry;

1.8.12 Automation, Control and Monitoring:

1. Integrated building automation system (BAS) and backbone communications network for monitoring and control of critical systems (see BAS specifications for scope);
2. Building management system (BMS) for the control and monitoring of critical cooling and ventilation infrastructure (see BMS specifications for scope);
3. Electrical management system (EMS) for the monitoring of electrical systems (see EMS specifications for scope);
4. UPS backed HMIs, networking equipment and outstations for all BAS, BMS, EMS systems;
5. Plant and equipment monitoring and alarm management;
6. Interface with fire and security systems;

1.8.13 Vertical Transportation:

1. Two (2) 5440 kg goods lifts;
2. One (1) 870 kg passenger lift.

1.8.14 Building Works in Connection:

1. All works in connection with the building services installations;
2. External plant room enclosures;
3. Primary and secondary supports for building services installation;
4. Open mesh grating to the gantry to suit the building services installation;
5. Provision of sleeving and fire stopping to all penetrations with an approved packing system, including future;
6. Louvre screen on gantry;
7. Access stairs and platforms for plant access and maintenance;
8. Provision of future penetrations to operational areas;

9. All civil engineering works associated with external and internal below ground services. The Contractor shall be responsible for coordinating the external to internal below ground services as required to suit the services required under the Contractor's scope.

1.9 Energy Efficiency

01 A key aspect of the project is to maximise energy efficiency and products should be selected to minimise energy usage across the range of climatic conditions for the site location.

02 The Contractor shall design all systems to be energy efficient and wherever possible select equipment from the Energy Technology List to enable the Client to benefit from Enhanced Capital Allowances (ECAs). Where equipment is subject to ECAs, the Contractor shall provide original invoices/receipts to enable these to be claimed.

03 IT equipment that is integral to the design and operation of the building's critical infrastructure systems, such as UPS systems, generators, cooling systems, BMS/EMS, and others, shall be procured in compliance with the 'EU Code of Conduct on Data Centres – Best Practice Supplement, Version 2'.

04 The peak PUE will be sufficiently low, to ensure that the IT load, as well as all critical and ancillary loads can be supported both by the generator capacity at N and the utility connection.

1.10 Contractor Design Responsibility

01 The Contractor scope of works is based on a Design & Build Contract and includes further elements of Contractor design where it is the responsibility of the Contractor to provide the complete detailed design to RIBA Stage 4 and also provide the specialist Contractor, manufacturer or installer with the design intent detailed in this document and develop up to full detailed design and construction / installation drawings.

02 Contractor Design Responsibility covers elements of the Works that requires design development by the Contractor for:

1. RIBA Stage 4 detailed design as specified in the Employer Requirements.
2. Systems, equipment or facilities that are provided with a performance specification within the Tender Documents.
3. Systems, installations or facilities that require design verification due potential variances during execution of the Works.
4. Systems, installations or facilities whose satisfactory performance is reliant upon criteria ascertained during the construction Works.

03 The Contractor retains design liability for all the elements of the Works.

04 The Contractor must familiarise themselves with the reference standards, specifications and Contract requirements which may expressly identify or infer the Contractors design responsibility along with the works identified below:

1. Tender Pack: The tender drawings are generated from a BIM/ Revit model that has been developed to the level of detail in accordance with RIBA Stage 3, In accordance with BSRIA BG6/2018 – A Design Framework for Building Services.
2. The Contractor shall further develop the level of detail to;

a) RIBA Stage 4 level for detailed design model, drawings and documents as outlined in Appendix E : Stage 4 deliverables list, as well as any documents required for customer requirements compliance outlined in the DDI.

b) RIBA Stage 5 level for Shop Drawings & Material Submittals

c) RIBA Stage 6 level for As-built Drawings/Model at Handover

d) RIBA Stage 7 level for Record Drawings at completion of the defects period to capture any subsequent changes

05 Temporary Works: Works that are required to facilitate the Permanent Works.

06 Builders work: Final coordination of builders work openings, fire stopping, and design responsibility for all openings.

07 Structural steelwork frame: The Contractor shall engage a Specialist Supplier/ Sub-Contractor to validate the design intent, modify as necessary and provide additional detailing to provide a structure that is fit for purpose fulfilling the Contract Requirements with respect to load capability, bracing, deflection and frame stability etc. Submit details to the Engineer for approval.

08 Equipment plinth / base: Contractor to design, supply and install based on equipment final approved selections.

09 Services brackets, hangers and supports, including secondary steel work;

10 All secondary/final cable containment

11 4G/5G telephone system: The Contractor is to refer to the initial design that has been prepared by Infrastructure Wireless Italiane (INWIT) for the basis of the costing. The design is performance based and is to be developed by the Contractor and INWIT including all power supplies and associated fixings required for the correct operation of the system. The Contractor is to ensure full compliance with local code and EN/UNI standards. Submit details to the Engineer for approval.

12 Automatic controls including BACS and the main system backbone.

13 Anti-vibration mounts;

14 Secondary steelwork to support MEP services: Sizing and selection of cable/ pipe supports, drop rods, secondary containment, secondary steelwork including that for data hall future fit-out containment etc. Submit details to the Engineer for approval.

15 Fire-fighting systems: The design is performance based, the Contractor is to ensure full compliance with local code and EN/UNI standards. Submit details to the Engineer for approval. Contractor to refer to Fire Protection sections of this document for specific requirements.

16 Voice evacuation, fire detection and alarm systems: The design is performance based, the Contractor is to ensure full compliance with local code and EN/UNI standards. Submit details to the Engineer for approval.

17 Diesel fuel and urea system: Note that the design and supply of the fuel system will be by the Generator vendor. However the Contractor shall coordinate with the Vendor's design and shall be responsible for the installation of the entire diesel fuel distribution system ensuring full compliance with local code and EN/UNI standards. Submit details to the Engineer for approval.

18 Earthing system: Final design and selection of earth ring/rods by the Specialist Supplier based upon measured ground conditions. Submit details to the Engineer for approval.

19 Lightning protection: Contractor to engage a Specialist Supplier to validate the design intent, carry out a LPS risk assessment and select specific products that will be fit for purpose and fulfil the Contract Requirements. Submit details to the Engineer for approval.

20 PV system: The design is performance-based, the Contractor is to ensure full compliance with local regulations. Submit details to the Engineer for approval.

21 Transformer Enclosures: All transformers that will be installed internally in the building will need to be provided with enclosures that will limit the EMC emission value to <3µT in all permanently occupied areas i.e. offices, adjacent to the TX rooms. All values are to be in line with D.P.C.M 8/7/2003 and DM 29/05/2008.

22 Equipment plant replacement strategy in line with final equipment selections, installation and manufacturers recommendations.

23 Pump heads: Contractor to undertake hydraulic calculations prior to pump procurement to validate pump heads based upon the Contractors proposed, and approved, system configuration.

24 Pipework expansion/ movement: Contractor to design mitigating pipework expansion/ movement provisions to address thermal expansion and building movement upon supported pipework related to the fire protection systems.

25 Fan external static pressures: Contractor to undertake external static pressure calculations prior to fan procurement to validate fan ESP's based upon the Contractors proposed, and approved, system configuration.

26 Trace Heating for all externally exposed pipes. (Fire Protection, condensate drain, water supply) including calculations, selection, supply, installation, test and commission.

27 Water treatment system: Stage 3 drawings show design intent only. System shall be designed, installed, tested and commissioned by a specialist Contractor. It's Contractor responsibility to identify incoming water quality and select proper water treatment equipment to satisfy minimum water quality requirements.

28 The Technical Standards for Construction ("Norme Tecniche per le Costruzioni - NTC") require the determination of seismic demand for the design of non-structural elements and in particular for elements assembled and installed on site. When installing the equipment and system components and coordinating the necessary accessory works, the Contractor must comply with the requirements of NTC 2018 in relation to the class of use considered for the structural design. The seismic demand emerging from the site seismic hazard and the related response has been studied in detail by the structural engineer, with reference to NTC2018 as per DM 17/01/2018, par. 7.2.3. All regulatory references, technical data, calculation results related to these considerations are to be found in the structural design documents. The Contractor is therefore required to consult the latest revision of the tender documents included in the structural design in order to verify their congruence and to correctly dimension the plant engineering building services, and related brackets and handlings and for support and stability.

29 Seismic provisions: Contractor to design the seismic control provisions, including but not limited to the following as required by the local authority and seismic requirements.

1. Wire sway bracing to fire-fighting pipework.
2. Restraint of fuel system pipework.
3. Restraint of life-safety control panels and equipment to preserve their operation during and after a seismic event.
4. Restraint of electrical panels and other floor standing that pose a risk of injury should they topple during a seismic event.
5. Bracing and restraint for all electrical cable containment and equipment fixings.

6. Associated fire-stopping detailing where lateral movement of the above mentioned pipework at wall penetrations is required.

30 Design of pipework flushing strategy.

31 Refrigerant pipework and accessories: Contractor to engage a Specialist Supplier to review the refrigeration pipework design and modify as necessary to suit the air-conditioning equipment of the Specialist Supplier to ensure a complete and fully functioning system. Submit details to the Engineer for approval.

32 Design, supply, install, test and commission VRF systems and fan coil units within front of house spaces including but not limited to electrical connections, controls, sensors, ductworks, refrigerant pipes, insulation, grilles, dampers etc.

33 The requirement for Leak detection associated with VRF refrigerant system shall be checked and verified by the Contractor and their specialist sub-Contractors, subsequently any necessary detectors, sounders, and control system shall be installed to ensure full compliance with European F-gas regulations.

34 The Contractor shall design, supply, install, test and commission leak detection on all critical spaces room, condensate drainage, and refrigerant pipes passing above the critical space.

35 The Contractor shall provide all necessary support to the Nominated Supplier such as civil work/ scaffolding/ power/ water/ storage for their day to day material and installation work. Any civil rectification, if required, to fit the specified equipment will be the responsibility Contractor as part of his coordination responsibilities.

36 The Contractor shall coordinate directly with the system integrator and shall provide coordinated shop drawings and as-built drawing for the approval of the Engineer. The drawings shall include all details of the equipment and installation details such as cut outs, core drills, power cables and containment, mechanical and electrical connections etc.

37 The Contractor shall be responsible for coordinating equipment level testing by the Nominated Supplier. The Contractor shall be wholly responsible for functional system testing and integrated system testing to ensure system interfacing and operationally unison in accordance with the sequence of operation.

38 The Contractor shall be responsible for coordination and interface with any third party design such as but not limited to security.

1.11 Testing, Commissioning and Setting to Work

1.11.1 General

01 This section shall be read in conjunction with Stack's Testing and Commissioning specifications and the Project Documents.

02 The Contractor shall appoint a specialist Contractor to carry out the testing and commissioning of the various systems.

03 All systems shall be fully tested and commissioned; however, a proportion of the tests will be conducted in the presence of the Client's representative.

04 All services in voids and raised ceilings shall be signed off by the Client's representative prior to closure.

05 All fire safety systems shall be demonstrated in the presence of the Client's representative and the local fire authority, which shall include inspection, releasing and resetting of all fire dampers installed in the ductwork system.

06 The Contractor shall provide attendance on the Electrical Services Contractor during the fire alarm testing to confirm the cause and effect operates as required for the mechanical plant.

07 At the outset of the project the Contractor, when programming the works, shall ensure that sufficient time is allocated for the proper testing, commissioning and setting to work of all the systems.

08 The employer shall engage a specialist company (a Commissioning Agent) to oversee and validate the Contractor commissioning and testing.

09 The General Contractor shall appoint a company to carry out the onsite management.

10 The requirements for testing and commission are described in the project documents.

1.11.2 Method statements

01 For each stage of the commissioning a written method statement shall be submitted by the Contractor for comment four weeks prior to the event.

02 In addition to a detailed schedule of the proposed tests, the method statements shall include methods of connections, test equipment connection plans, time schedule, itinerary for factory tests, tabulated expected results, pre-requisites and a method of recording any corrective actions.

1.11.3 Factory testing

01 Witness factory testing shall include the following systems

1. Air-cooled chiller with free cooling – one chiller to be factory tested;
2. Data Hall air handling units – one of each type to be factory tested;
3. Generator – one of each type to be factory tested;
4. Power Module – one of each type to be factory tested;
5. BAS / EMS / BMS graphics;
6. MV/LV transformer;
7. LV switchboard - one of each type to be factory tested.

02 The Contractor shall allow for all associated costs including travel and accommodation for four (4) Client representatives.

03 Where travel requires flights, this is to be economy class. Hotels are to be a minimum of 4* standard.

1.11.4 Site testing

01 Site testing of equipment shall be carried out prior to commissioning as detailed in the project documents and witnessed by the Clients representative.

1.11.5 Commissioning

01 The Contractor shall ensure adequate time is allowed for commissioning the individual parts of the system.

02 The Contractor shall provide a comprehensive commissioning and witnessing plan four weeks in advance of the commissioning period for approval by the Client and Engineer.

1.11.6 Commissioning records

01 Officially certified commissioning records shall be provided to the Client and engineer on completion of the tests.

2.0 EMPLOYER'S REQUIREMENTS

2.1 General Requirements

01 The end requirement is to provide an independent data centre building (MIL08A) within a secure campus adjacent to MIL08B.

02 The building shall be capable of delivering 20 MW of IT power to the data centre environment in a secure, resilient manner and in compliance with the Customer's requirements..

03 MIL08A will be fully designed constructed and completed in its entirety physically with all structural and services infrastructure elements.

04 Primary electrical power shall be derived from the existing onsite 132/22kV substation provided under a separate contract.

05 Contractor shall pay attention to interfaces with other phases and operational sites and allow for integration of the required interfaces across the different buildings. Contractor shall plan the works in coordination with stakeholders to avoid any interruptions to operational areas.

06 The Contractor shall provide the complete detailed design for the site and facilities including but not limited to all design calculations, engineering studies, drawings and 3D models as detailed in the project and contract documents, in-line with the BIM execution plan provided by ARC:BIM and quality standards set out by the Client. **Refer to Appendix E for list of minimum expected deliverables for RIBA Stage 4.**

07 The project shall comply with the Customer's Liquid to Liquid SOQ requirements. **Refer to Appendix B for the project in progress SOQ Matrix.** The Contractor is required to provide design documentation and engineering reasoning necessary to demonstrate compliance with SOQ requirements whether mentioned in this document or not.

08 The project is to follow STEER-BWE-XX-XX-RP-N-00004 - STACK BOD V P01 - Stack EMEA European Reference Design (Steer), with localization. **Refer to Appendix C for the project specific Steer deviation tracker agreed with Stack.**

2.2 Scope

01 The scope for MIL08A shall include but not be limited to the following:

1. The entire perimeter fences;
2. Site clearance and slab break up to allow construction;
3. The site access gates and the control of those gates;
4. Any roadways detailed;
5. All landscaping under footprint;
6. The full construction of the buildings including the completed structure, foundation, roof, walls and fenestration and the provision of all access and egress, internal walls, circulation and base services;

7. All civils works, drainage, duct laying, trenching, carpark, roads and foundations, balancing and retention ponds and sub structures;
8. Establishment of all incoming utilities to the site and to buildings;
9. Control of the site access gates;
10. External lighting and security for MIL08A, and the wider site;
11. Fit out of for each of the Computer Rooms comprising, and all associated critical and ancillary systems;
12. Full fitout to a CAT B standard of all client offices, welfare, security rooms, toilets, showers and stores within the building on the ground level;
13. For the scope relating to the Base Build and Fit Out of Customer Areas, please refer scope demarcation provided by Stack.
14. Provision of engineering stores and workshops;
15. The construction of the plant rooms, computer rooms, corridors, security access, tube locks and escape paths;
16. All engineering, fire, lighting and small power required for the landlord systems to support the non-critical elements of the building;
17. All engineering, power, lighting, fire alarm, fire suppression and ancillary services and cable containment provisions required to fully support computer rooms deployment and the critical infrastructure, including all energy metering to comply with all statutory regulations etc;
18. All temporary, or otherwise, services in relation to the fallow areas;
19. All perimeter security including fence, gates and CCTV;
20. All building main security including the full fitout of the security operations centre (SOC);
21. A facilities operations centre (FOC);
22. Provision of plant goods lifts;
23. Provision of passenger lift;
24. All required acoustic treatment;
25. All required fire protection and fire protections systems.
26. Interface with existing site and substation.

3.0 PERMITTING

01 A Building Permit must be obtained prior to the start of construction of MIL08A, as well as MIL08B (two different and separate Building Permits).

02 The two Building Permits should be coordinated with each other and consistent with the "*Piano Attuativo*" (Implementation Plan) already approved for the whole site and which also affects an external service area and a new public road ("*Nuova Variante alla Strada Provinciale 205 Vigentina*") with a roundabout.

03 The Building Permit referred to MIL08B will be handled by a separate consultant team and is not covered in this document.

04 The permitting approval process for MIL08A briefly includes:

1. Building Permit;
2. Fire Department Evaluation;
3. Environmental Permits (V.I.A., A.I.A., etc.).

05 The contractor shall pay particular attention to the requirements of the permit to ensure that all engineering systems comply with these requirements. The Contractor shall be responsible for compliance and the submitting for all documentation as required to grant permit approval.

1. This shall include any calculations and other technical documentation required for all necessary statutory legislative / permitting applications (example but not limited to: Emissions, Thermal Load, Calculations, Drawing, etc).

06 The Contractor shall ensure that any proposed design solution or design change complies with applicable urban planning parameters and technical regulations.

The Contractor shall be responsible for submitting updated permitting drawings as required to support any addendums required resulting from the Contractor's detailed design.

4.0 ARCHITECTURE

4.0 Description of the intervention plan

00 MIL08A is a new build datacentre located in Siziano Borgo Casatico site approx. 13km far from Milan Linate Airport on the South-Est side of Milan. The campus will include two independently operated data centre buildings, where MIL08A is 20 MW and the other Data centre will provide 5 MW both of which with dedicated attached office support block.

01 MIL08A will be constructed part of a campus consisting of 2 data centre buildings for Stack MIL08A & B. MIL08B is being designed by a separate consultant team. The power to MIL08A will be fed from a new substation serving serving the entire campus, which will be built in the immediate vicinity.

02 The building in composed by two main areas: the datacentre and the office block.

03 The datacentre will be divided into 2 Data Halls of 6MW IT and into 2 Data Halls of 4 MW IT with its technical MEP galleries, providing for a progressive data halls set-up.

04 The adjacent office building includes both working spaces and datacentre support spaces (as loading dock, Tenant storages,maintenance offices, FOC, Entrance Room, Meet Me Room, etc…).

05 In order to ensure the daily operation of the Data Center additional technical volume located on the perimeter of the lot are planned (e.g., Guardhouse, Waste Room, Pump Room, Fire Department Room, etc.).

06 No specific certifications are required for the project:

1. LEED/BREEAM/WELL certification: not required;
2. UPTIME Institute certification: not required;
3. ANSI TIA 942 certification: not required.

4.1 Data Center Buildings

00 The main function of the technology hub is as a Data Center, that is, an industrial site with the presence of "Data Rooms" where the digital process is developed, that is, the storage, processing and treatment of digital data.

01 The datacentre will be divided into 2 Data Halls of 6MW IT and into 2 Data Halls of 4 MW IT with its technical MEP galleries, providing for a progressive data halls set-up.

02 "Data rooms" are generally leased in whole or in part to digital market operators. In accordance with the current market, the operators involved require the need for the most advanced security systems, management and processing of personal data, as well as continuity of service, 24/24h 365 days a year.

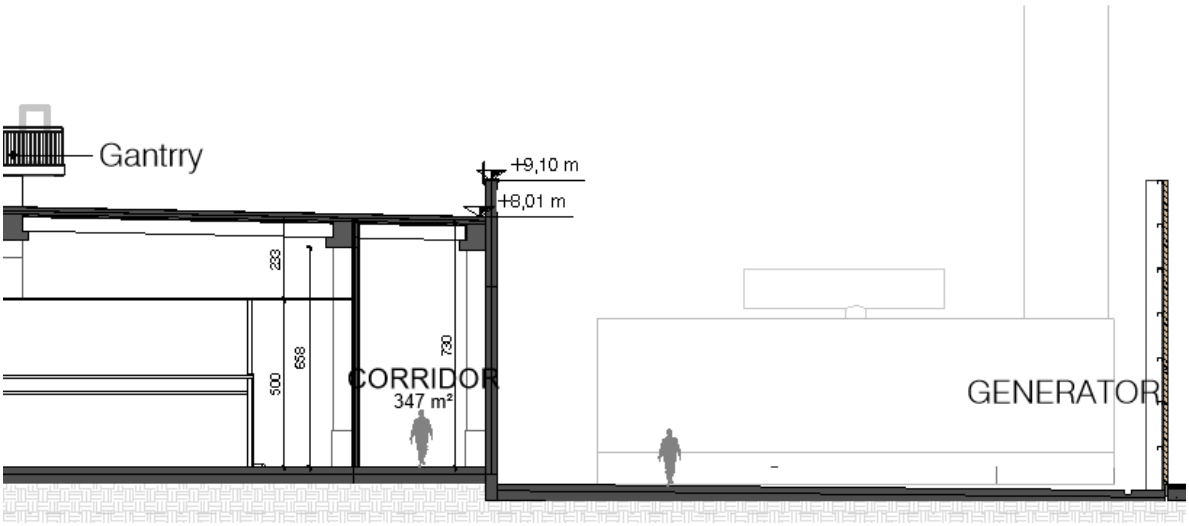
03 The design includes the arrangement of data halls on the ground floor only of the actual data centre volume

04 Regarding the project reference elevations, the ground floor of the buildings for Data Center use is built 50 cm above ground level in order to avoid risks from possible flooding that would compromise the functionality and operation of the technology hub.

05 In order to ensure the functionality of the system, the "Data Rooms" are provided with technological systems that require a minimum ceiling clear height of about 5 meters. This height derives from the need that in the "Data Rooms," in addition to the server cabinets of standard height of about 2.6 meters, electrical and mechanical systems are to be provided that cannot interfere with each other and are necessary for the proper operation of the racks, such as power supply systems (electrical conduits for racks power supply), cable trays for connectivity/telecommunications data transmission, lighting system, fire detection and extinguishing and other special systems, as well as air conditioning and air control for racks cooling.

06 This equipment must be arranged on well-segregated spaces in order to ensure optimal conditions of safety for operators and maintainability of the facilities themselves over time without the need for out-of-service of other portions of the facility. In addition, hot and cold air flow channels are separated into differentiated pathways (hot and cold aisle compartmentalization) that allow servers to operate under controlled and optimal hygro-thermal conditions.

07 In light of these plant and technological needs, the height under beam for the Data Hall is therefore 6,58 meters as per the section proposed below:

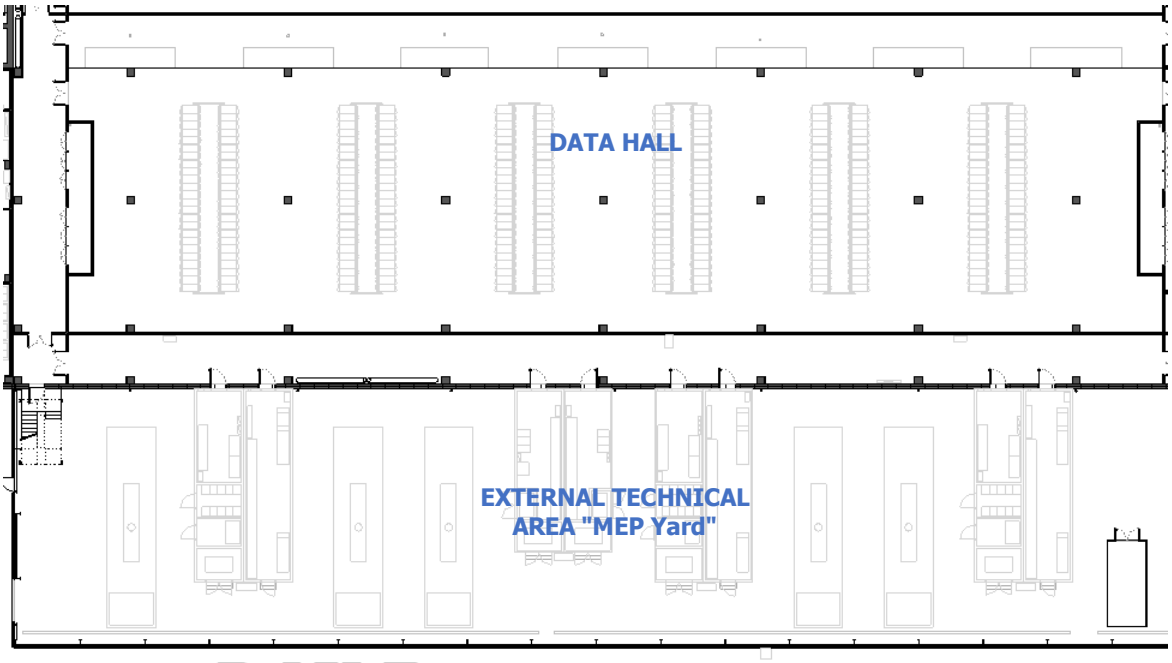


Detail section

08 As a result, e Data Center building is characterized by a height to the intrados of the beam on the top habitable floor of the office building, which is equal to 10.00 meters

09 In contrast, the height of the crowning front (parapet) is at an elevation of about 9,1 meters for Data Centre building and 12,45 meters .

10 Outside the Data Center buildings there is a technical area (MEP Yard) with a metal structure in which the Diesel Generators, energy transformation and storage rooms, and air conditioning, pumping, and fire-fighting systems are located. These rooms are built using prefabricated containers or insulated sandwich panel systems. This technical area is identified in plan in the graphic design drawings.



Floor plan: Ground floor area "Data Hall"

11 The outdoor units of the plants are installed on the roof, and consist of mechanical equipment for indoor space conditioning (Chillers, AHUs).

12 On the roof of the main building and on the canopies covering the internal car parks and part of private car parks for public use, photovoltaic panels are placed to serve the building.

13 In addition, the following mitigation works for plant sources are introduced inorder to fall within the zone noise limits:

14 Equip each chiller group with sound barriers on 4 sides, with heights equal to: 3.00 m.

15 Finally, the office block directly connected to the Data Center is on two levels and thus reaches a greater height than the data room block, which is on a single level on the ground floor.

4.2 Buildings Composition

00 The main building consists of two adjacent and communicating blocks; the main one used for Data Center while the smaller ancillary block is used for Offices.

01 The two buildings part, although communicating on the ground (+0.50m), are structurally independent being separated by structural separation joint. In addition, the roof of the data hall can be reached via internal stairs and an internal lift in the office block.

02 The Data Center, given its modularity, size and loads, is composed of a predominantly precast concrete structure (pillars, beams and "double-T" tiles); at the roof, it is the inclination of this structure (2%) that provides the slope for stormwater runoff.

03 Reinforced concrete wall baffles are provided to ensure the horizontal load resistance of the building.

04 The data rooms are provided with structural metal ceiling placed at a height of 5 m from the floor level.

05 The facade is entirely composed of sandwich panels with metal substructure. These panels have the various RAL colours). (See elevation drawings for more details).

06 The office block is composed of the same precast concrete structural system. Also for this block, the roof is sloped with a slope of 2%. Stairway, freight elevator and elevator blocks are made of cast-in-place RC partitions.

07 On the ground floor, for areas with permanence of people, a floor is planned with Foamglas-type panel insulation, while on the upper floors, insulated screeds floors are planned in office areas and screeds in bathrooms and technical rooms.

08 In the office block, the facade is composed of insulated composite sandwich panels with glazed curtain walls in order to guarantee the aero-illumination ratios requested by law. The latter ensure also for natural ventilation of the rooms.

4.3 Physical security

00 The project shall comply with the Physical Security Baseline for B-Class Facilities.

01 Perimeter: The project includes a complete perimeter fence system around the property. The fence will be 2.4 m high, set back not less than 3 m from the property line. The design will use impact-rated materials (Ameristar Stalwart IS M30/P2 or equivalent) in areas with vehicular access, and non-rated materials (Ameristar Impasse II Stronghold or equivalent) in other publicly visible areas. Trees, vegetation, and any material that could aid a breach or provide concealment will be cleared 10 ft (3 m) on both sides of the fence.

02 Main Entry: The site will have a single point of normal access with a two-lane sliding gate (matching the fence style), three-lane impact-rated barrier arms (B&B ARMR 773E-M30 or equivalent), traffic lights, safety loops, a personnel turnstile, and stanchions for access control and communication.

03 Guardhouse (Security Equipment Control Panel/Enclosure): A guardhouse is provided in the project at the facility entrance to process visitors and control entry systems. The guardhouse will operate 24/7 and allow remote control of the facility entrance.

04 Facility: Access control doors will not have relites (windows) or glass inserts, except for the main lobby and office entrances. Door hinges will be installed on the secure side or secured (with a setscrew or welding) to make them tamper-resistant from the non-secure side. Door locks will be keyed to the facility's master key system. For budgeting purposes, most functional areas will be secured with card reader access and video cameras. Exceptions to access control include break rooms, restrooms, conference rooms, janitor closets, and interior nested offices.

05 Entry Lobby: Lobby furnishings will be low-profile and arranged to allow clear visibility of all areas by Security Operations Center (SOC) personnel. This includes furniture, plants, screens, displays, and televisions. A restroom and conference room will be located in the entry lobby to restrict access to more secure areas of the facility. Access from the lobby to the interior will be through a three-door "storefront" system.

06 Security Operations Center (SOC) The SOC will be located adjacent to the building lobby, accessed through a single door from within the secure datacenter. The windows and walls between the lobby and the SOC will be constructed with forced entry-rated materials.The SOC will accommodate up to five people (24/7) and include an office area and a lockable storage room. Two "deal drawers" will be installed to service lobby visitors.

07 Administrative Areas: The project includes access control provisions for open offices and the facility operations center as per the Physical Security Primer for B-Class Facilities. Individual offices, conference rooms, janitor closets, and libraries are designed to be manually lockable. Break rooms will be freely accessible. Single-user restrooms will be lockable from the inside with a flip-turn lock and feature a mechanism to display the occupancy status to those outside. Multiple-stall restrooms will be key-lockable from the outside only. Shower areas will be equipped with a weather-sealed panic button.

08 Loading Dock: The project includes card-in, card-out readers for interior doors separating the Loading Dock from Receiving and exterior personnel doors. Roll-up doors will be installed between the facility exterior and the Loading Dock platform. These doors will be metal and solid when closed, with no openings or windows that allow visibility inside. Each loading dock door will have Open/Stop/Close buttons, with the card reader activating the exterior roll-up door controls. A valid badge read will enable the Open push-button, while Close and Stop buttons will remain active at all times. The loading dock will also be equipped with a single-person restroom.

09 Receiving/Staging: Entry doors from the data center corridor into Receiving will be equipped with card-in readers, allowing free egress. A roll-up door will be installed between the Loading Dock and the Receiving area. These doors will be metal and solid when closed, with no breaks or windows that allow visibility inside.Each receiving/staging area dock door will have Open/Stop/Close buttons. A valid badge read will enable the Open push-button to open the door. Close and Stop buttons will be active and available at all times.

10 Asset Management: The office will be accessible only from the Receiving Area and feature panoramic windows that provide a clear view of the Loading Dock, Receiving Area, Secure and Storage. Windows between the Asset Management office and the Loading Dock will be equipped with reflective tinting or internally operated shades to prevent those outside from seeing clearly into the office while allowing staff to see out.

11 Secure Storage: The entry door from the Receiving area into secure storage will be equipped with card-in, card-out readers and an EDR system.

12 High Value Storage: Entry door into high-value storage will be equipped with card-in, card-out readers and an EDR system.

13 Shred Room: Entry door into the shred room will be equipped with card-in, card-out readers and an EDR system.

14 Security Equipment Rooms (SER): The entry door will be equipped with a card reader for entry and a storeroom function lockset. The walls of the room will be full-height, slab-to-slab construction, and prepared with surface plywood backing to support equipment mounting. These rooms will have no carpeting or drop ceilings.

4.4 Functional areas

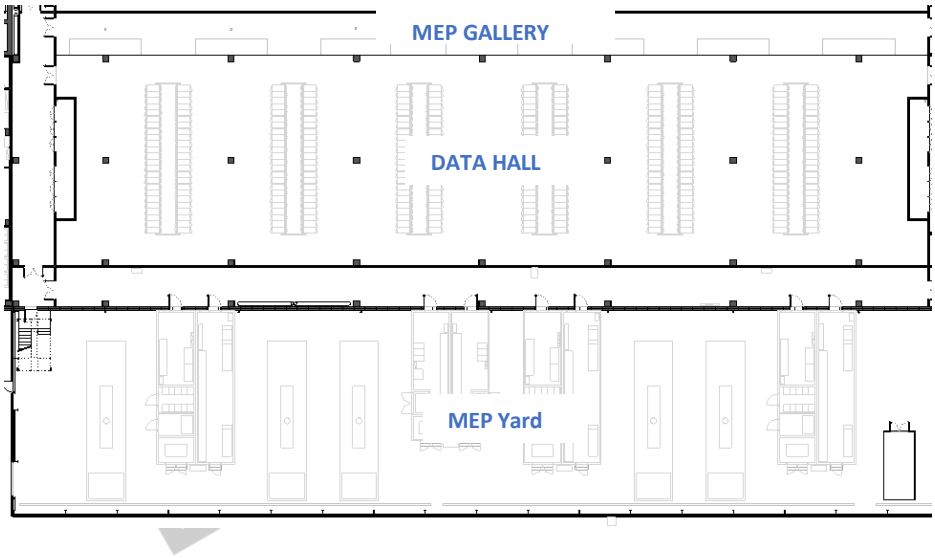
00 In detail, the project can be divided into the following functional areas:

1. Data Hall

2. MEP Gallery and Technical Corridor
3. External Technical Area "Gantry"
4. Offices
5. Toilet Facilities
6. Storages
7. Technical rooms

4.4.2 Data Hall

00 The project involves the construction of a total of No. 4 Data Halls: 2 Data Halls of 6MW IT and into 2 Data Halls of 4 MW IT.



Floor plan excerpt ground floor area Data Hall, MEP Gallery and Gantry

01 At the technical level, the Data Halls will be built with industrial floor and resin finish that can withstand high handling traffic and high weight loads.

02 The perimeter walls (toward the distribution corridors) will be made from floor to floor (h. 7 m approx.) with double fire-resistant gypsum board sheet to ensure REI60 protection. The separation wall between Data Hall and MEP Gallery will be made with a solid metal sheet up to the height of about 5 m and for the part above with an open metal grating. This wall will be properly fixed to the metalwork provided by the structural design and will be shaped in relation to the air conditioning machines (FanWall) in the MEP Gallery. The entire Data Hall will have a structural metal ceiling at h.5 m capable of supporting the loads of the catwalks and all the systems planned in the hall.

03 The access doors to the Data Hall will be metal, fire resistant REI60 and integrated with access control system. They will have dimensions 180x305 cm to allow entry of all necessary equipment.

4.4.3 MEP Gallery and Technical Corridor

00 The design envisions for each Data Hall an adjacent technical space called MEP Gallery that can contain the main electrical and mechanical units serving the Data Hall itself (Fan Wall, etc.).

01 At the technical level, MEP Galleries and corridors will be built with industrial floor and concrete dusting finish with additives that can withstand high handling traffic and high weight loads.

02 The perimeter walls (towards the distribution corridors) will be made from floor to floor (h.6,5 m approx.) with double fire-resistant plasterboard sheet to ensure REI60 protection. The separating wall between MEP Gallery and Data Hall will be made with a solid metal sheet up to the height of about 5m and for the part above with an open metal grating. This wall will be properly fixed to the metalwork provided by the structural design and will be shaped in relation to the air conditioning machines (FanWall) in the MEP Gallery. Finally, for the corridor near the external façade, the wall in contact with the outside will be made of sandwich panels with metal substructure and REI60 fire resistance. All plant crossings in the perimeter walls will have to be properly sealed while maintaining the REI60 compartmentalization of the building envelope.

03 Access doors to the MEP Gallery and the technical corridors will be metal, fire resistant REI60 and integrated with access control system. They will have dimensions 180x305 cm to allow entry of all necessary equipment.

4.4.4 External technical area "Gantry"

00 The design envisions for each Data Hall a technical area outside the building, and adjacent to the Corridor, called the Gantry. This area will consist of a MEP yard which will house the bulkier electrical and mechanical equipment such as Power Modules, Diesel Generators, Pump Rooms, Fire Protection Rooms, serving the interior of the building.

01 At the technical level, on the ground floor, the Gantry area will have a floor with a 1% slope to ensure rainwater runoff, except for the portions with the technical rooms and generator area and power module. This area will be constructed with exposed finished industrial floor, and will be suitably reinforced with structural slabs at the heaviest facilities (e.g., generators, etc.).

02 The separation wall between the internal corridor and the MEP Yard will be made of sandwich panels with metal substructure and REI60 fire resistance. All plant crossings in the perimeter walls shall be properly sealed while maintaining REI60 compartmentalization of the building envelope.

03 The entire MEP Yard area will be bounded and protected by a metal louvered fence h.9 m and accessible through 4 single doors and 2 sliding gates located on the perimeter. Additional metal doors will be provided for access to the technical rooms.

04 Finally, 4 external metal staircase will be built to connect the ground floor of the Gantry to the data hall roof.

4.4.5 Offices

00 The design includes for the main building a portion dedicated to offices, storage, toilets and to general technical rooms serving the interior of the building.

01 Office space includes various rooms both for the Tenant's exclusive use and for the Property's exlcusive use (e.g. FOC, Meeting Room, Assistant Critical Facilities Manager etc.).

02 At the technical level, the offices will be built with floor insulation layer, concrete screed and carpet tiles finish.

03 The walls will be made slab to slab height with double standard gypsumboard. In the case of walls adjacent to technical rooms or storage rooms these will be appropriately made in order to ensure REI60 compartmentalization of the elements. Walls in contact with the outside will be made with insulated composite sandwich panels.

04 The facade of the admin block is composed of insulated composite sandwich panels integrated insulation in order to ensure thermal break.

05 The exterior windows and doors will ensure natural air exchange and natural lighting and will consist of single-hung sash windows size 105x210cm RAL 7046 and with reflective glass to prevent vision from outside to inside.

06 All offices will have a gypsum board ceiling with 60x60 squares, all at h.3.15m.

07 Access and distribution doors inside the offices will be metal and appropriately equipped with an access control system.

4.4.6 Toilet Facilities

00 The design includes for the main building a portion dedicated to offices, storage, toilets and to general technical rooms serving the interior of the building.

01 Toilet use spaces include various rooms shared by the Tenant and the Property (e.g. Men's Bathroom, Women's Bathroom, Disabled Toilet, WC, Shower, Cleaning, Driver WC etc.).

02 At the technical level, the restrooms will be built with a floor consisting of reinforced screed and lightened screed with a porcelain tiles finish that will cover both the floors and walls of the rooms so as to ensure cleanliness and hygiene for these rooms.

03 The walls will be made from slab to slab with double hydro gypsumboard. In the case of walls adjacent to technical rooms or storage rooms these will be appropriately made in order to ensure REI60 compartmentalization of the elements. Walls in contact with the outside will be made with insulated composite sandwich panels integrated insulation in order to ensure thermal break, double-sheet hydro gypsum board counterwall.

04 The facade of the admin block is composed of insulated composite sandwich panels integrated insulation in order to ensure thermal break.

05 The exterior windows and doors will ensure natural air exchange and natural lighting and will consist of single-hung sash windows size 105x210cm RAL 7046 and with reflective glass to prevent vision from outside to inside.

06 All toilets will have a single-slab hydro smooth gypsum plaster ceiling, varying in height h.3.15m.

07 Access, and interior distribution doors will be metal.

4.4.7 Storages

00 The project includes dedicated storage spaces both within the admin block and in the data centre block integrated insulation in order to ensure thermal break.

01 Storage spaces include several rooms both for the Tenant's exclusive use and for the Property's exlcusive use (e.g. Maintenance Storage).

02 At the technical level, the warehouses will be made with industrial floor concrete dusting finish with additives that can withstand high handling traffic and high weight loads.

03 The walls will be made from slab to slab height with fire-resistant gypsum board double sheets to ensure REI60 protection. Walls in contact with the outside will be made with insulated composite sandwich panels integrated insulation in order to ensure thermal break.

04 All storage rooms will have no false ceiling; the structural floor will remain exposed.

05 The access doors to the storage rooms will be metal, suitably equipped with access control system and must provide fire resistance for REI60 compartmentalization of the rooms.

4.4.8 Technical rooms

00 The project includes technical rooms, serving the interior of the building spaces, in the admin block.

01 At the technical level, the technical rooms will be built with industrial floor and concrete dusting finish with additives that can withstand high handling traffic and high weight loads.

02 The walls will be made from slab to slab height with fire-resistant gypsum board double sheets to ensure REI60 protection. The walls in contact with the outside will be made of precast concrete panels with thermal break.

03 All technical rooms will have no false ceiling; the structural floor will remain exposed.

04 Access and distribution doors inside the technical rooms will be metal, suitably equipped with an access control system and must provide fire resistance for REI60 compartmentalization of the rooms.

4.5 Overcoming Architectural Barriers

00 Actions for the elimination of architectural barriers are represented by the set of works aimed at allowing vertical and horizontal accessibility of a building or space, to people with disabilities, these actions are enshrined in the technical prescriptions provided by the following legislation:

1. Regional Law February 20, 1989, No. 6 - Standards on the elimination of architectural barriers and technical prescriptions for implementation;

2. Law No. 13 of January 9, 1989 - Provisions to encourage the overcoming and elimination of architectural barriers in buildings - as amended;

3. D.M. 14.06.1989 No. 236 - Technical prescriptions necessary to ensure the accessibility, adaptability and visibility of private and subsidized public housing buildings for the purpose of overcoming and eliminating architectural barriers;

4. Circular Min. ll. pp. June 22, 1989, No. 1669/U.L.: explanatory circular of Law no. 13; Ns. Ref. I.4.3.1.2.0010_Relazione Tecnica Opere Civili.Doc 24/25;

5. Law February 5, 1992, No. 104 - Framework law for the assistance, social integration and rights of handicapped people;

6. Presidential Decree No. 503 of July 24, 1996 - Regulations containing standards for the elimination of architectural barriers in public buildings, spaces and services.

7. Presidential Decree No. 380, June 6, 2001 Articles 77-78-79-80-81-82 Unified text of and regulations on legislative building provisions, Chapter III Provisions to encourage the overcoming and elimination of architectural barriers in private, public and private buildings open to the public;

01 This regulation is applied according to the achievement of several requirements:

1. Accessibility: the possibility even by people with reduced or impeded motor or sensory capacity, to reach the building/space, to enter it easily and to enjoy all the environments in conditions of adequate safety and autonomy.

2. Visitability: the possibility, including by people with reduced or impeded motor or sensory capacity, to access relationship spaces and at least one toilet. Relationship areas are those of service and meeting places, in which the citizen enters into relationship with the function performed there.

02 In this regulatory scenario, in the design of the office area of the buildings for Data Center use, in order to overcome architectural barriers, the technical requirements of Ministerial Decree 236 June 14, 1989 necessary to ensure the accessibility and visitability of private places open to the public and R.L. 6 February 20, 1989 were implemented.

03 Toilet facilities

1. As stipulated in Article 5.4 of R.L. 6 Feb. 20, 1989, the new restrooms will have the following minimum performance:

   a) Outward-opening or sliding doors and interior clearance to ensure the rotation of a wheelchair or in any case not less than m. 1.35 x 1.50 between the sanitary fixtures and the door opening clearance;

   b) Space for the wheelchair to be side-to-side with the toilet bowl, if any, shower or bathtub;

   c) Equipping the appropriate horizontal and vertical handrails made of steel pipe and an emergency bell placed near the toilet bowl.

04 Flooring

1. The floors, consistent with Article 5.5 of R.L. 6 February 20, 1989, will ensure the following minimum performance:

   a) Be non-slip and therefore made of suitable materials that also ensure their perfect flatness and continuity;

   b) Do not have even minor variations in level, such as those due to unrecessed doormats or raised rails.

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4.6 Construction types

00 This chapter briefly describes the main construction types used within the project. For generalities, mode of execution, reference standards, acceptance requirements, performance specifications, mode of sampling/testing, testing, guarantees, and exact stratigraphy of each element refer to Technical Specifications document.

4.6.2 Vertical Stratigraphies

00 According to the design requirements, the interior partitions will be plasterboard walls or plasterboard counterwalls.

01 The thickness, height, and performance requirements of these walls are variable and depend on the type of use of the same. These will consist of slabs, structure and insulation.

02 The exterior boards, in the number of 2 per wall, will be made of 12.5 mm thick type A coated gypsum, fire reaction class A2-s1 d0 (non-flammable) and screwed to the metal frame. Depending on the type of wall, these slabs will be combined together to achieve fire resistance with EI60 certification. On the other hand, in correspondence with wet rooms, the slab will have to be of the "hydrolastic" type with water absorption after 2 h of total immersion < 10% by weight. These partitions shall in any case have constant thickness and dimensions (tolerance ± 0.4 mm) with parallel, smooth faces and high mechanical strength.

03 The supporting structure may be single or double cold-bent galvanized steel, consisting of "U" profile rails of width 50, 75 and 100 and "C" uprights of width 50, 75, 100, thickness 0.6mm, in fire resistance class A1.

04 The insulation layer where provided will be mineral wool with varying density according to design requirements. The panels will be 40/60/80mm thick depending on the size of the metal wall structure (see abacus vertical interior partitions).

05 Each wall must be in compliance with the design indications with regard to the aspects listed below and for which the Contractor shall provide the relevant certifications:

1. fire behavior class;
2. fire resistance;
3. Soundproofing power;
4. Sound absorption coefficient;
5. thermal conductivity;
6. Operating shock resistance;

06 The façade of the admin block and data hall block consist of vertical sandwich composite panel (CW02), 310mm thick, Trimo QBiss One system type laid on metal carpentry at the expense of the Structural Project, having the following main technical characteristics:

1. reaction to fire: A2-s1, d0
2. fire resistance: EI 60
3. transmittance 0.22 W/m2K

07 The volumes enclosing the mechanical systems consist of vertical metal walls made of sandwich panels with rockwool thickness 60mm, laid on metalwork at the expense of the Structural Design.

08 Refer to the sheets for more details: MIL08A-L22-DC-XX-DR-A-22201 Wall Abacus

4.6.3 Doors and Windows

00 Interior and exterior doors will be metal hinged or sliding type, with one or two leaves, installed on plasterboard, sandwich panel or precast concrete panel walls.

01 They may vary in size, in height and width. The most common sizes vary in height from 210,240, 280, 305 cm and width from 80, 90, 120, 150, 180, 250 cm.

02 According to the design indications, where required, the doors should possess integral EI60 approval and be prepared for cold smoke sealing (sa) with appropriate gaskets.

03 Doors can be equipped with key lock or electro lock of Cisa-Ninz, Assa-Bloy EL560 or Assa-Bloy EL561 type and handle of fire and accident prevention type complete with plate placed at height mm 960.

04 The installation of push-bar type panic device, on the escape route, should follow the design directions and be placed at a height of 960 mm from the ground.

05 The doors will be made of hot-dip galvanized steel and consist of:

06 Fixed frame made of hot-dip galvanized steel profile sp mm 15/10 Z-profile, conformed to allow sash-frame coplanarity, properly anchored to the wall structure so as to ensure stability and tightness of the entire window frame; -

07 Coplanar sash to the frame made of double 8/10 hot-dip galvanized steel sheet press-folded;

08 Lower frame rebate adaptable to the finished floor, or removable, for execution without rebate.

09 The finish will be done by painting with epoxy-polyester powders heat-cured in an oven at 180°, surface with scratch-resistant embossed texture, color RAL 7046 to be sampled for approval. To allow air exchange in the rooms some doors may have the leaf consisting of metal grille attached to the frame, of 13x13x3mm mesh, or be raised 3cm from the ground.

10 Doors for outdoor use shall be certified for:

1. Wind load resistance and water tightness
2. Thermal insulation
3. Air permeability

11 The exterior windows will be thermal break aluminum with double-hung casement and reflective glass to prevent viewing from the outside, size of 105x210 cm, color RAL 7046 to be sampled for approval. The main features are::

1. hinges: concealed
2. aluminum treatment: Ox
3. opening system: manual
4. insulated metal casing (depth see drawings)
5. glazing: 33.1+16+33.1 o P5A - 44.1 4S+15+44.
6. extra glass: radon gas + hot runner
7. - Ug=1.0 W/(m2k)
8. UW value: 1.2 W/(m2k)
9. Burglar-proof: class RC3 (where required by the project)

12 They are attached to the metal substructure of the facade by suitable fastening/anchoring systems. Interior windows will be fixed with extruded metal profiles with thermal break in primary aluminium alloy, size 120x135, color RAL 7046 to be sampled for approval. The main features are:.

0 soundproofing power: 44 db

1 burglar-proof: class RC3

2 fire resistance: EI60 where required

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3 glazing provided: double glazing with laminated, shatterproof glass consisting of laminated safety glass with polyvinylbuterral (PVB) interposed or laminated glass with polycarbonate interposed; level 3 bulletproof resistance. These windows will be attached to the RC3 interior intrusion-resistant security partition wall by suitable fastening/anchoring systems. They will be installed together with the respective document pass-through.

13 Interior windows will be fixed with extruded metal profiles with thermal break in primary aluminum alloy, size of 105x210 cm, color RAL 7046 to be sampled for approval. The main features are:

1. soundproofing power: 44 db
2. burglar-proof: class RC3
3. fire resistance: EI60 where required
4. glazing provided: double glazing with laminated, shatterproof glass consisting of laminated safety glass with polyvinylbuterral (PVB) interposed or laminated glass with polycarbonate interposed; level 3 bulletproof resistance. These windows will be attached to the RC3 interior intrusion-resistant security partition wall by suitable fastening/anchoring systems. They will be installed together with the respective document pass-through.

14 Graphic reference works:

1. MIL08A-L22-DC-XX-DR-A-89205-Door Abacus Details
2. MIL08A-L22-DC-XX-DR-A-89201-Door-Window Abacus

4.6.4 Horizontal Stratigraphies

00 Floors are divided into interior and exterior stratigraphies.

01 Interior floors will have different stratigraphies to support five types of surface finish. The most common coating inside buildings is resin with epoxy multilayer flooring type Mapei Mapefloor System 32, final thickness 2mm on concrete substrate, for industrial-type flooring with high chemical resistance, impermeable to oils and aggressive agents, resistant to frequent washing, wear caused by trolleys and moving vehicles, and with marked non-slip effect. The resin must be laid perfectly coplanar and with adequate joints. Where people are expected to stay, the stratigraphy is integrated with insulation and the appropriate membranes and sheathing (HF01-FL04).

02 All technical spaces, storage rooms and corridors in the data centre block will be finished with a concrete dusting finish with additives such as Mapecrete Lithium Protector final thickness 3mm on concrete substrate, for industrial-type flooring with high chemical resistance, impermeable to oils and aggressive agents, resistant to frequent washing, wear caused by trolleys and moving vehicles, and with marked non-slip effect

03 In wet rooms such as bathrooms, cement-effect porcelain stoneware tiles such as Marazzi Apparel color Clay size 60x60cm thickness 1 cm are provided, glued on screed with variable type and thickness depending on the type of stratigraphy. Sheathing, vapor barrier and insulation are provided in these floors, but the thickness of this could vary depending on the plant passages .

04 For the lobby space at ground floor and break area at first floor, a natural stone granite finish such as Salvatori, model Crema d'Orcia Select Levigato tk. 9mm, is provided, glued on screed with variable type and thickness depending on the type of stratigraphy. Sheathing, vapor barrier and insulation are provided in these floors, but the thickness of this could vary depending on the plant passages.

05 The carpet finish floors, for the ground and second floor offices, are carpet tiles such as Interface Syncopation color Ocean dim. 50x50 cm sp. 4.80mm, resting on screed with variable type and thickness depending on the type of stratigraphy. Sheathing, vapor barrier and insulation are provided in these floors, but the thickness of this could vary according to the plant passages .

06 The stratigraphy of the roof consists of an exposed BROOF t2 exterior floor composed of single PIR insulation (100 mm) with a conductive glass veil layer on the top of it for testing and research discontinuity and exterior finish with double waterproof membrane and surface protective layer. This is a flat roof with a slope of 2% .

07 The volumes enclosing the mechanical systems are made of self-supporting horizontal sandwich metal panels (RS03) 80mm thick, laid on metal carpentry at the expense of the Structural Project.

08 The other external stratigraphies are for:

1. Self-levelling outdoor cabin flooring, 1 cm thick
2. Washable outdoor floor with waterproofing for waste room, thickness 2.5 cm
3. the sidewalks with outdoor self-locking concrete pavement with Carnic gray finish, 75 mm thick, variable dimensions
4. the green areas
5. the asphalt for internal roads and parking lots
6. the self-locking concrete paving for external parking

09 Refer to the sheets for more details: MIL08A-L22-DC-XX-DR-A-23201 Floor Abacus Details

4.6.5 Ceilings

00 All suspended ceilings provided for in the project, should be executed with special care in order to obtain exactly horizontal surfaces.

01 The installation shall always be carried out in accordance with the diagrams and installation materials prescribed by the supplying companies or according to the diagram produced by the Contractor and approved by the Construction Management.

02 Suspended ceilings will generally consist of panels of standardized dimensions, in the assembly of which, carried out in adherence to or with detachment from the surface to be covered, care must be taken so that the best coplanarity and perfect adherence of the edges is achieved.

03 The installation shall always be carried out in accordance with the schemes and installation materials prescribed by the supplying companies or according to the scheme produced by the Contractor and approved by the Works Management at the height established in the project drawings, H 320 or H 240 cm from the floor level, to be verified on site.

04 The panels should be easily removable to allow replacements or inspections to any cavities above.

05 In execution, perfect agreement will also be required between the firms performing the installations, whether electrical, thermal or air conditioning in general.

06 The types of ceilings in the project are:

1. Inspectable suspended ceiling made of Knauf-type mineral fiber squares, consisting of supporting metal frame on concealed galvanized steel T-structure, secondary T-profiles installed at a spacing of 600mm and coated gypsum panels of 600x600mm, thickness 9.5mm

2. Water-repellent gypsum board single-slab lowered ceiling -HUMID ROOMS- on double metal frame independently of the floor above .

3. EI60 fireproof interior membrane ceiling type Knauf K 219 self-supporting on metal frame, insulated, with inspection hatch, 14cm thick.

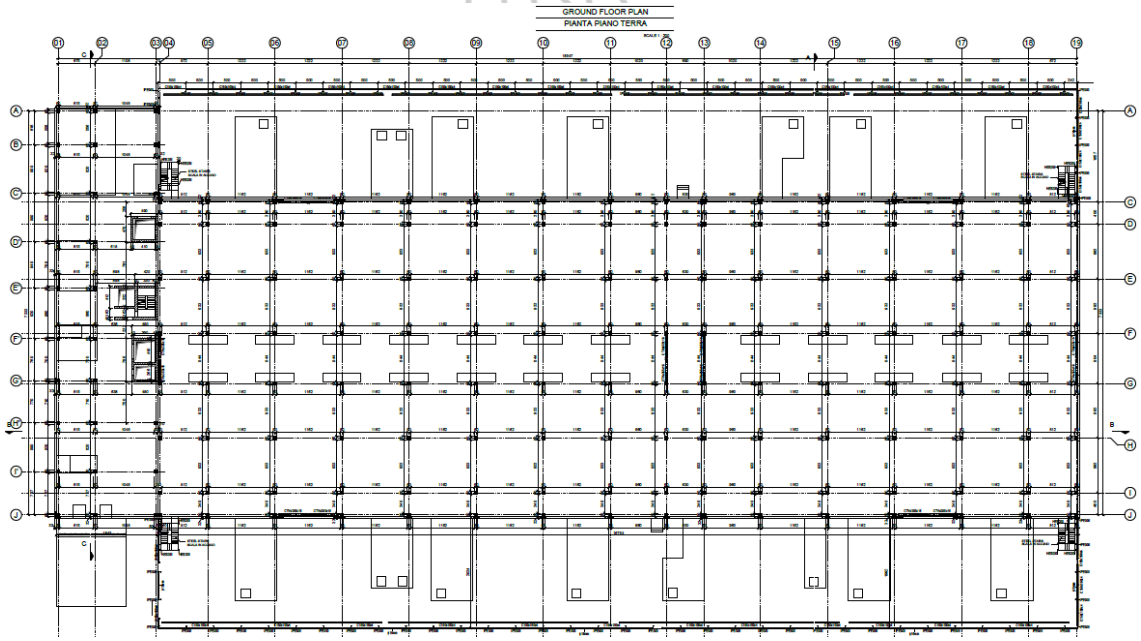
4. Metallic structural ceiling type Kingspan Tate Grid tailed 120×120cm with 120x60cm metal panels, thickness 12mm, for maximum point load 3.56 kN.

5.0 STRUCTURE

5.1 GENERAL INFORMATION

01 This chapter concerns the structural considerations

02 The structural floor plan layout is shown below.



Floor plan layout

03 Building complex main dimensions:

- Data hall module 166mx58m (one-story);
- Office building 18.0m x 75m (two-story).

04 For data hall and office building, precast concrete structures are provided. Instead, for the gantry on the roof a steel structure is proposed.

05 With reference to horizontal action, for office, RC shear walls equipped by nonlinear fluid viscous dampers is proposed; for DH vertical brace equipped by non linear fluid viscous damper is proposed. This lateral resisting system guarantees the full operation of the infrastructure even for earthquakes with high return periods. This topic is an important requirement for a data center infrastructure.

06 Seismic joints are provided for office-data hall and ad for RC shear walls and slab of the office.

07 With reference to the foundations, considering the mechanical properties of soil obtained from previous investigations, in order to reduce the settlements, isolated pile caps with piles having a diameter of 60cm and depth of 15m are provided. The differential seismic movements on the foundation plane are resisted by the ground floor slab.

5.2 REFERENCE STANDARDS

01 The calculations must be performed according to the Limit State method, in compliance with the following standards/laws:

1. DPR 06.06.2001 n° 380: “Testo unico delle disposizioni legislative e regolamentari in materia edilizia” modificato e integrato ai sensi del D.Lgs 27.12.2002 n° 301.
2. D.M. 17.01.2018: "Aggiornamento delle Norme tecniche per le costruzioni".
3. Ministero delle Infrastrutture e dei Trasporti – CIRCOLARE 21 gennaio 2019, n. 7 - Istruzioni per l’applicazione dell’«Aggiornamento delle “Norme tecniche per le costruzioni” di cui al decreto ministeriale 17 gennaio 2018.
4. CNR-DT 207 R1/2018: “Istruzioni per la valutazione delle azioni e degli effetti del vento sulle costruzioni”.
5. CNR-DT 211/2014: “Istruzioni per la Progettazione, l’Esecuzione ed il Controllo delle Pavimentazioni di Calcestruzzo”.
6. UNI EN 15129, antiseismic device.

02 Where not in conflict with the rules indicated above, reference may be made to:

1. UNI EN 1992-1-1 “Eurocode 2: Design of concrete structures - Part 1-1 : General rules and rules for buildings”.
2. UNI EN 1992-4 “Eurocode 2: Design of concrete structures - Part 4: Design of fastenings for use in concrete”.
3. UNI EN 1998-1 “Eurocode 8: Design of structures for earthquake resistance -Part 1: General rules, seismic actions and rules for buildings”.
4. UNI EN 1997-1 “Eurocode 7: Geotechnical design – Part 1: general rules”.
5. UNI EN 1993-1-1 “Eurocode 3: Design of steel structures - Part 1-1: General rules and rules for buildings”.
6. D.M. 31.07.2012 “Approvazione delle Appendici nazionali recanti i parametri tecnici per l’applicazione degli Eurocodici”.

5.3 MATERIAL PROPERTIES

01 Concrete for foundations

Class	C35/45
Exposure class	XC2
Design compressive strength	fcd = 21.17 MPa

02 Concrete for elevations

Class	C35/45
Exposure class	XC3
Design compressive strength	fcd = 21.17 MPa

03 Concrete for precast elements

Class	C45/55
Exposure class	XC1
Design compressive strength	fcd = 25.86 MPa

04 Reinforcing steel bars

Ordinary steel grade	B450C
Characteristic tensile strength	ftk ≥ 540.00 MPa
Characteristic yield strength	fyk ≥ 450.00 MPa
Design strength	fpd = 391.3 MPa

05 Prestressing steel

Characteristic 1% proof stress	fp(1)k = 1670 MPa
Characteristic tensile strength	fptk = 1860 MPa
Design strength	fpd = 1452.2 MPa

06 Steel for profiles

Structural steel grade	S355
Characteristic tensile strength	ftk ≥ 510 MPa
Characteristic yield strength	fyk ≥ 355.00 MPa
Design strength	fyd = 338.1 MPa

5.4 DESIGN LOADS

5.4.1 General information

For the loads involved in this project the references are shown below:

01 Codes

Loads	NTC18(Italian standard) based on Eurocodes

02 Factor of safety (partial factor at Ultimate Limit State)

Dead loads	1.3
Live (imposed) loads	1.5

03 Specifically:

1. Superimposed Dead load (SID) includes ceiling, hung loads and finishes;
2. Live Load (LL) includes equipment weights, maintenance load and partition walls.

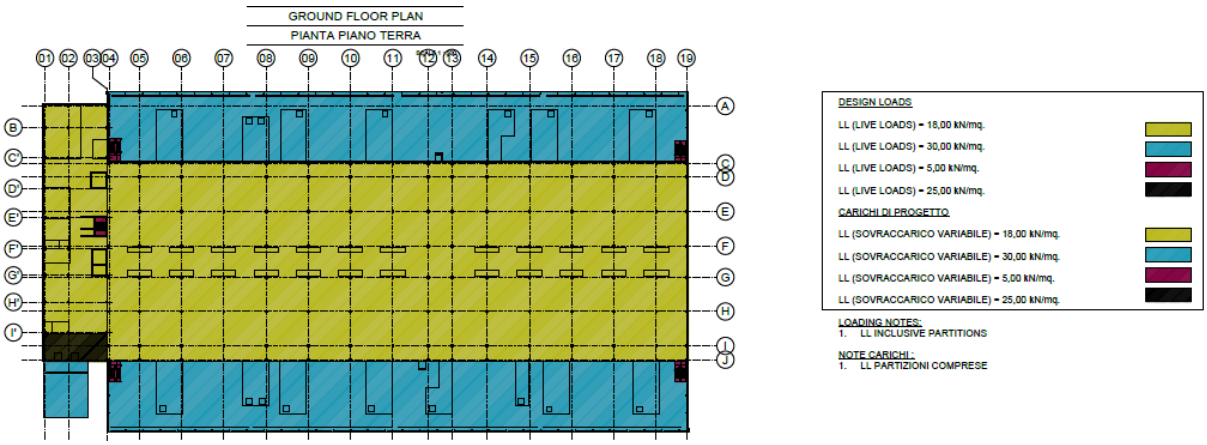
04 Building structural capacities will be adequate for the weight and layout of server racks and equipment as defined by Tenant operations. In areas where heavy loads (racks) are expected, raised floors are not provided.

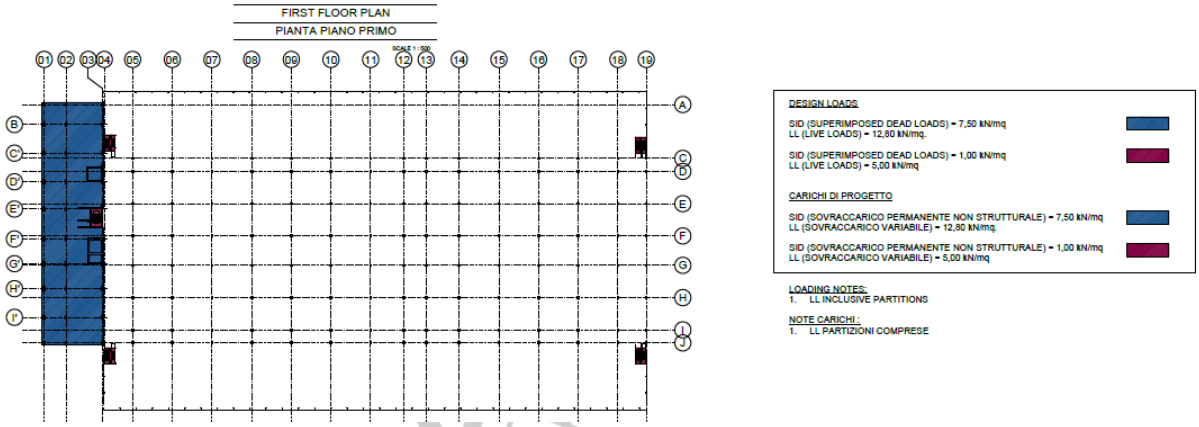
5.4.2 Vertical load

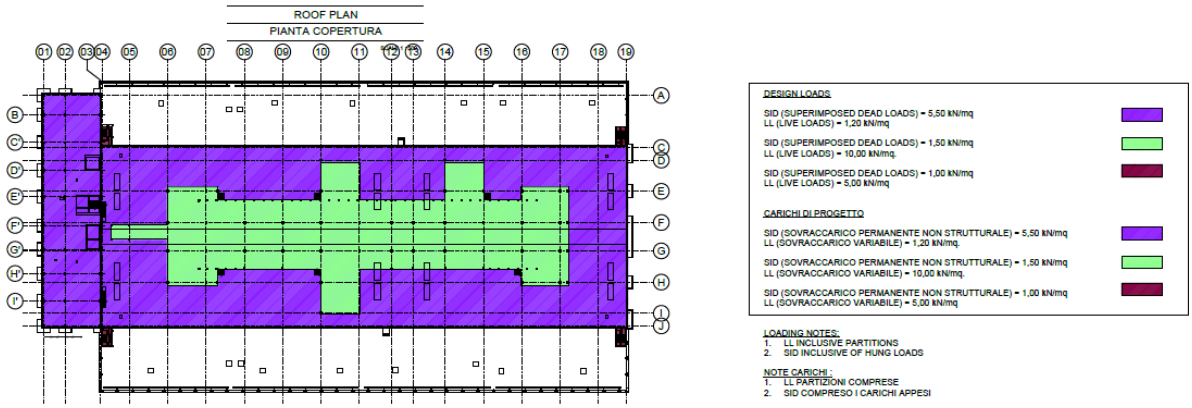
01 The unit weight of the materials is equal to:

1. Steel γa = 78.5 kN/m3
2. Reinforced concrete γc = 25.0 kN/m3

02 In the following figures load plan are shown.







5.4.3 Snow

01 For the Municipality below are listed the snow parameters:

1. Site altitude as = 93m s.l.m.
2. Snow load on the ground: qsk = 1.50 kN/m2 (Zona I-Mediterranea, as < 200 m s.l.m.)
3. Shape coefficient: $\mu 1$ = 0.8 (pitch inclination $0 \leq \alpha \leq 30°$).

4. Thermal coefficient: Ct = 1,0.
5. Exposure coefficient: CE = 1.0

02 In accordance with the Ministerial Decree 17.01.2018, with these parameters the snow load on the structures is equal to:

$q_s = \mu_1 \times q_{sk} \times C_E \times C_t = 1.20$ kN/m2

5.4.4 Wind load

01 Wind pressures are calculated in accordance with current legislation:

1. Zone 1: Lombardy.
2. Soil roughness class D.
3. Exposure category II.
4. Return period TR = 50 years.

02 The wind pressure is given by the expression:

$$p = q_b \times c_e \times c_p \times c_d$$

q_b is the reference kinetic pressure;

c_e is the exposure coefficient;

c_p it is the shape coefficient (or aerodynamic coefficient), a function of the type and geometry of the construction and its orientation with respect to the direction of the wind;

cd it is the dynamic coefficient with which the reductive effects associated with the non-simultaneity of the maximum local pressures and the amplifying effects due to structural vibrations are taken into account; assessed in accordance with Appendix L of the CNR DT207 R1/2018 (cd=0.8 applied only to the wind impacting the building, for acoustic barriers cd=1.0).

03 Since the altitude above sea level of the site where the construction stands is less than a0 = 1000 m above sea level, the reference speed is:

$$v_r = v_b = v_{b,0} = 25 \text{ m/s}$$

04 Therefore, the reference kinetic pressure is:

$$q_b = 0.5 \times \rho \times v_b^2 = 390.63 \text{ N/m}^2 \ (\rho = 1.25 \text{ kg/m}^3\text{, air density})$$

05 Once the soil roughness class and the exposure class of the site have been set, it is possible to identify the parameters that define the exposure coefficient, such as:

$$k_r = 0.19$$
$$z_0 = 0.05 \text{ m}$$
$$z_{min} = 4.0 \text{ m}$$

06 The exposure coefficient ce, a function of the height z above the ground of the point considered, was evaluated using the following expressions:

$$c_e(z) = k_r^2 c_t \ln(z/z_0) [7 + c_t \ln(z/z_0)] \text{ per } z \geq z_{min}$$
$$c_e(z) = c_e(z_{min}) \text{ per } z < z_{min}$$

07 The topography coefficient (c_t) was assumed to be equal to 1.

08 The aerodynamic coefficients were calculated in accordance with paragraphs C3.3.8 of circular n. 7/2019 for buildings. Instead, for acoustic barriers/walls, reference was made to Appendix G.5 of the CNR DT207 R1/2018.

Cp	Cd	Ct	Ce	z
1,00	1,00	1,00	2,13	12.3 m

Pressione del vento

p = qr Ce Cp Cd = 83 daN/mq

5.4.5 Fire resistance

01 Fire resistance for concrete structure (roof, precast panels, columns): R60'

02 Fire resistance for gantry structure: R15'

5.4.6 Thermal variations

01 In accordance with paragraph 3.5.5 of the NTC18 and specific requirements of Client, the following uniform thermal variations are considered:

1. for no exposed concrete structures +30/-15°C;
2. for the exposed steel structures +/-50°C;

5.4.7 Seismic action

01 According to the Ministerial Decree 17.01.2018 all the parameters necessary for the definition of the seismic action are defined according to the geographical coordinates of the site, the characteristics of the ground soil, the intended use of the structure and the probability of exceeding associated with a certain limit state.

02 The site in question is identified by searching by coordinates.

Region:	Lombardy
Municipality:	Siziano
Longitude:	9.214115
Latitude:	45.324619
Nominal Life:	V_N = 50 anni
Use class II:	C_u = 1.0
Soil category:	Cat. C
Topographic category:	T1

03 It should be noted that the nominal life/use class are not taken as basic data in the calculation of the return period of the seismic action for the different limit states. The required performance levels were defined in agreement with the Client as follows:

04 Operation status (SLO) → TR = 1950 anni;

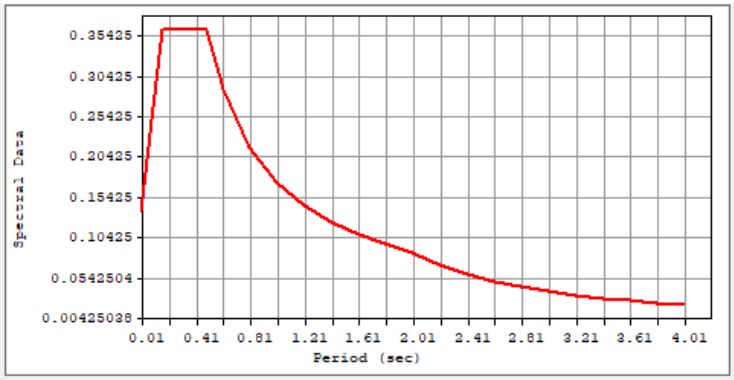
05 Strength/no collapse (SLC) → TR = 2475 anni.

06 The return periods mentioned above largely satisfy the requirements of the national NTC18 regulation.

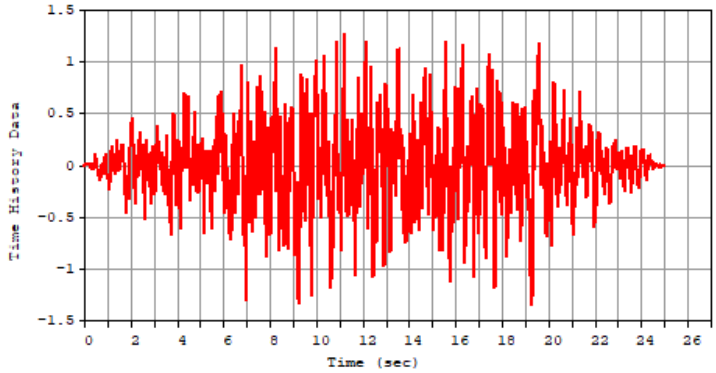
07 The seismic analysis was conducted using non-linear dynamic time history analysis (FNA). Therefore, the seismic action was characterized, for the two limit states considered, by means of time histories of the ground motion, applied simultaneously in the two directions.

08 In accordance with paragraph 3.2.3.6 of the NTC18, sets of artificial accelerograms were used. Spectrocompatibility with the reference spectrum for the limit state considered was verified in accordance with the criteria defined in paragraph 3.2.3.6 of the NTC18.

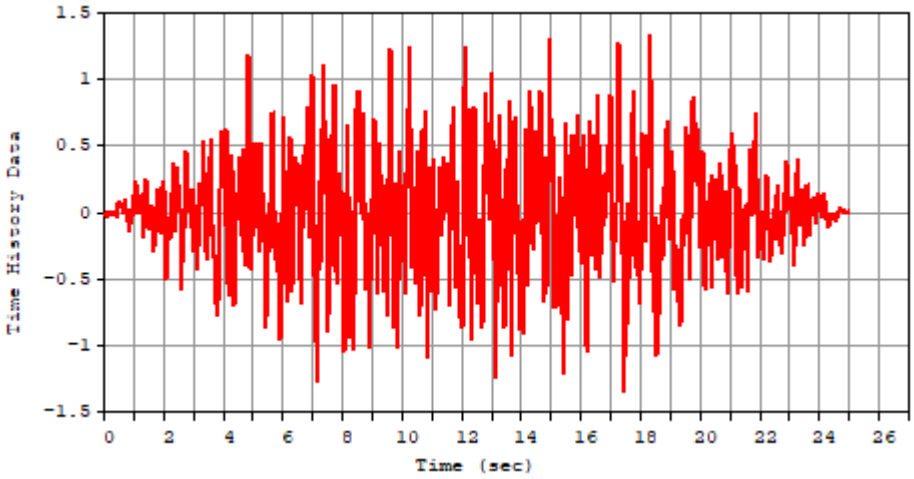
09 The reference elastic spectra and the corresponding spectrocompatible accelerograms are reported below.



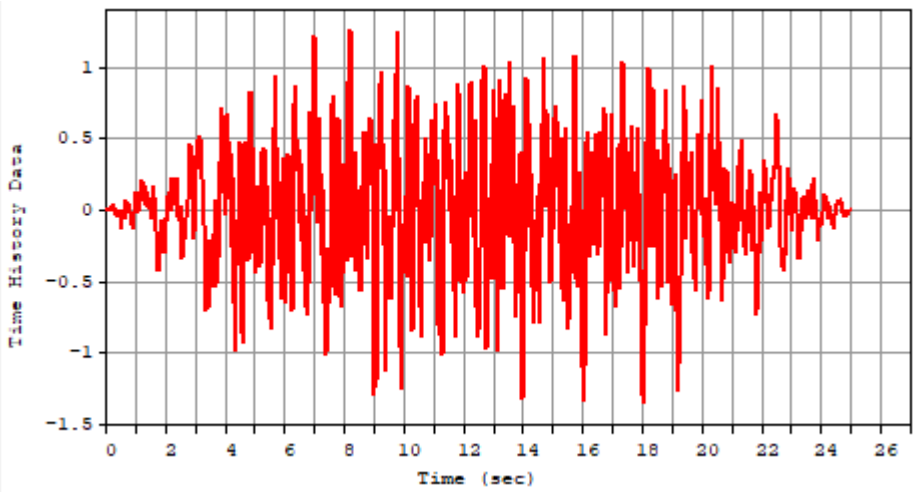
Elastic spectrum 2475 years



Accelerogram 1 – 2475 years



Accelerogram 2 – 2475 years



Accelerogram 3 – 2475 years

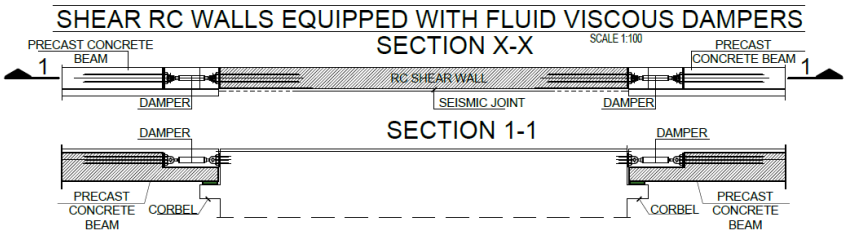
10 The checks are performed in terms of stiffness with respect to the SLO, resistance of the structural elements and displacement capacity of the antiseismic devices with respect to the SLC. RIG checks are performed by referring, for the sake of safety, to the SLC (2475 years).

11 In accordance with paragraph 7.3.6.1 of the NTC18, the following limit of inter-storey displacement is assumed:

$$d_{rp} \leq 0.0033 \times h \text{ (data hall/offices)}$$

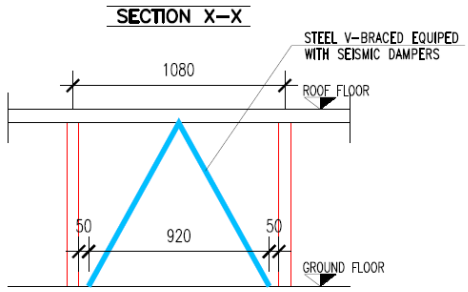
5.5 STRUCTURAL LAYOUT AND LATERAL RESISTING SYSTEM

01 The structural layout for data hall and office is composed by precast RC columns and shear walls. These latter are jointed and connected to the floors with FSD dampers.



02

Typical RC shear wall-floor connection by antiseismic devices



Typical bracing with dampers

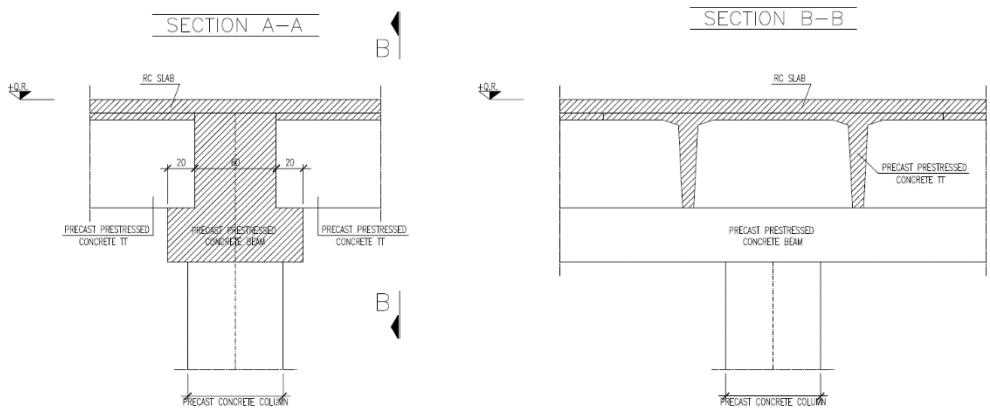
03 These systems concentrate the dissipation capacity in specially antiseismic devices, keeping the entire structure in the elastic range also for strong earthquakes. This requirement is fundamental for a data center, for which full operation should be guaranteed even for earthquakes with high return periods.

04 Furthermore, an elastic design would be uneconomical also with reference to the foundation structures, and a traditional design that consider the hysteretic dissipation of RC/steel members implies a high damage level of the structure by an earthquake having high return period and then unusability of the building.

05 Therefore, considering all the variables involved, the proposed solution appears to be the most efficient.

06 For data hall/office, the solution consists of:

1. Precast concrete column 60x60cm;
2. Prestressed precast concrete beam having inverted T/L cross section h=90 cm for first floor of office;
3. Prestressed precast TT element h=60cm for first floor of office;
4. Prestressed precast concrete beam having inverted T/L cross section h=80cm for first floor of data center and office;
5. Prestressed precast TT element h=50cm for the roof of data center and office;
6. In situ RC slab having a thickness of 10 cm.



07

Precast concrete solution for data hall/office

08 With reference to steel gantry on the floor plans, structural design provided:

1. Primary beam HEB650;
2. Secondary beam HEA450;
3. Horizontal bracing system ø30mm;
4. Steel grid.

5.6 STRUCTURAL REQUIREMENTS FOR MEP

01 In accordance with the limit states defined in the previous chapters and the use class of the structure (II), the following minimum requirements must be met:

Stability (resistance) for an earthquake having a return period of 2475 years.

02 The operation status of the systems is not necessary.

03 In addition, coordination with OFCI equipment was done with the information available during the RIBA3 stage (dimensions, technical specifications, etc.). During the RIBA4 it is imperative to continue this coordination and in RIBA5 phase it will be the GC's responsibility to adapt and coordinate the project with the suppliers of the various OFCI equipment taking into account the "Demarcation List" prepared by the client and also referenced in the DRM (Design Responsibility Matrix) attached to the contract.

6.0 CIVIL WORKS AND INCOMING UTILITIES AND SITE SERVICES

6.1 General

01 The site shall be stand alone and self-sufficient in respect of its power supply and fibre services. Dedicated new water services shall also be provided.

02 Separate fibre ducts shall be provided to each building to the local carriers from the access road to the site.

03 The contractor shall coordinate the position of all incoming fibre ducts provided under this contract with the local carriers, including the position of the boundary and zero manholes.

04 Drainage shall be discharged from the site into existing sewers and water courses with the introduction of interceptors and water attenuation. Please refer to the project documents for further details.

05 Generally, services are to be buried below ground. A basic principle applied to all service routes is to consider future expansion. Appropriate spurs / connection points shall be provided in key locations to facilitate this. The services to be considered are:

1. Potable and non-potable water;
2. Wastewater and Industrial water drainage;
3. Rainwater drainage;
4. Sprinkler and fire hydrant systems;
5. Fibre (both Stack and Tenant);
6. Electrical (lighting and small power);
7. MV power;
8. Extra Low Voltage services;
9. Security services.

06 The contractor shall arrange installation of metering in accordance with the requirements of the programme, and co-ordinate the installations within the Construction programme such that their installations are fully complete before the metering installation is undertaken. Where the meter provider is not known the contractor shall enquire with the Contract Administrator on the preference. This enquiry shall be made immediately on appointment of the Main Contract.

07 Utility services comprise:

1. Drainage –Municipality;
2. Water Supply – Municipality;
3. Telecommunications – Carrier neutral services;
4. Gas Supply – no gas provided to the site;
5. Electricity – The feeders from the local HV/MV substation.

08 The contractor shall employ a specialist civil engineering contractor, to design and coordinate all external and internal below ground services with respect to the water table, ground level, other below grounds services, structure and sitewide biotope area. Particular attention shall be paid to ensuring the services are sufficiently deep within the biotope area with respect to the water table, and the structure within the building.

09 Particular attention shall be paid to the below ground fibre and MV cable duct / trenches, and their interfaces with the structure and foundations. Suitable allowances shall be made for pre-cast services openings and / or depth of buried services to enable coordination with the foundations.

6.2 Potable and non-potable Water

01 Potable and non-potable water system shall be provided by pehd pipes in pressure running around the campus from the plant of municipality to send water to the offices, the firefighting pressurization tank and the guardhouse.

02 The connection to the municipal water supply is located on the north-west side of the site and is currently under construction for the entire campus. From this point, potable water will be distributed across the site, filtered, and delivered through a main circuit to supply:

03 Potable water for offices and domestic hot water production.

04 Potable water for plant filling.

05 Then, there will be a second connection from Municipality water network to load the firefighting tanks on each site.

06 There will be also non-potable water coming from rainwater collected from the roof and diverted into underground tank. The system will be also provided with booster pumps to serve bib-taps and irrigation systems and water closet flushing.

07 Flowrate from the municipality, will be in a minimum/maximum range. For that reason, will be provided booster pumps for DHW.

08 To test the installation the contractor shall back feed the new main from the site construction main and observe and measure for leaks under mains pressure before back filling.

09 Water meter shall be located at the site boundary.

10 The service shall be installed within the site.

11 The water services are provided by the water supply authority.

12 The contractor shall coordinate with the water supply company and shall include all cost of the works and be responsible for the coordination of the water supply and the facilitation of the services onto the site.

13 Trenching and builders work associated with the new supply shall be carried out by the General Contractor and the contractor shall provide attendance during these works.

14 The contractor shall be cognisant of the soil conditions to determine the suitable pipe material to be employed.

6.3 Wastewater and Industrial Water Drainage

01 Two separate networks are planned on-site: one to collect wastewater generated by the toilets in the admin block and another for industrial water.

02 Industrial water will include discharges from the following plant systems:

- Discharge from the chilled water system and fire-fighting system (technical room);
- Discharge from the fire pressurization pump station and fire supply tank;
- Discharge from sprinkler systems;

- Discharge from cooling systems;

- Condensate drainage from the plant (chiller).

03 The sanitary sewage network will consist of PVC pipes with a slope of 1%.
The industrial wastewater network will be made of PVC pipes with a slope of 0.25%.

04 The entire network will be inspectable via chambers made of reinforced concrete elements with a driveable upper slab. Where necessary, manholes with marine ladders and inspection manholes made of cast iron in accordance with UNI EN 124, class D400, will be provided, with a manhole diameter of 600 mm for deep inspection chambers.

05

A sampling pit and a Braga-Siphon-type inspection chamber will be provided before the inlet of each public sewer located in the northern part of the building.

06 Two pumping stations are planned to discharge wastewater and industrial water under pressure, connecting them to the public sewer system through a new connection point, which is located on the north-east side of the site.

07 The contractor shall be responsible to liaise with the operators of the pumping station and coordinate his works accordingly to make final connections, including the provision of any calculation or third party witnessing that the pump house management team require.

6.4 Rainwater Drainage

6.4.1 Roof Rainwater Drainage

01 The design of the rainwater collection network includes gravity-fed collectors within the site, directing flow to two lamination tanks. From these tanks, water will be pumped via a lifting station to the discharge point located southwest of the building to be connected with the Roggia Speziana, the nearest existing watercourse.

02 The contractor shall be responsible for the full on site drainage installation and coordination with the local utility and the arrangement and payments for all connections.

03 The collection system within the area is organized into several distinct sub-systems:

- A system for collecting rainwater from the roof of the main building;

- A system for collecting rainwater from the drains serving the internal roads and parking areas.

04 Rainwater from the roof, being low in contamination, does not require specific treatment. However, for the other system, it was deemed necessary to treat the water before discharge into the public sewer, as it may be potentially contaminated with oil.

05 The entire network will be accessible for inspection through chambers made of reinforced concrete elements with a driveable upper slab. Where necessary, manhole chimneys with marine ladders and inspection manholes made of spheroidal cast iron, in accordance with UNI EN 124, class D400, will be used, with manhole diameters of 600 mm for deep inspection chambers.

6.4.2 Glycol containment

01 Considering that there are cooling systems on the roof, in which there is the presence of glycol water, it was considered as a precautionary measure to put in collection tanks in case of spills. The operation of this "emergency" system involves the installation of tanks dimensioned as first rain, in the two sumps adjacent to the tank there are two valves that under normal conditions, make the water flow into the main collector, in case of spillage, the valve on the main collector will be closed and the one leading to the tank will be opened so that the first rain water will flow into the tank having reached the maximum level in the tank, the second rain will continue to go into lamination.

02 The chiller units on the roof have a capacity of about 1100 l each. Considering the spillage of one chiller at a time, the glycol collection tanks were sized according to the volume of first rain resulting from the areas of influence associated with each individual tank, to which the spillage volume of one chiller was added.

03 Four glycol collection tanks having volume 15 m3, volume 25 m3 and volume 30 m3 are planned for the subject building.If the tank is used, it must be emptied, after analysis, by direct withdrawal through a pump. In case the water analysis shows no contamination or the results would be compatible with the current surface discharge, the withdrawn water, may be fed back into the downspout network or onto the street.

6.4.3 Oilwater drainage

01 Water from streets and parkings will be collected in main collectors, through storm drains and channels, consistent with the interference of the various subservices present. It was deemed necessary to treat the water before it enters the public sewer, as it is potentially oilwater, with a proper oil separator.

6.4.4 Diesel containment

01 Following the requests received from the competent authorities (MASE) regarding environmental matters, it is necessary to install a diesel containment system in case of accidental failure.

02 For this reason, four diesel loading zones have been identified where a maximum of two vehicles can park for tank filling operations.

03 The diesel truck will park in this designated area on the road, present at each of the 4 gantries around the building.

04 The area is physically delimited by drainage channels that will collect the spilled diesel on the roadway and direct it to a drain located at the roadside.

05 Downstream of the drain, there is a Y-branch.

06 Under normal conditions (no spillage), rainwater flows into the discharge line.

07 In the event of an accidental diesel spill, the line will be diverted to an underground tank made of internally waterproofed concrete with a volume of 30 cubic meters. This volume will be able to contain 1/3 of the diesel tank plus any moderate-intensity rain.

08 Additionally, a volume of about 1000 liters has been considered for washing the yard and pipes post-spillage.

09 The flow will be diverted through a pair of motorized valves, which will be manually activated by the operator present during the diesel loading operations.

10 The valves will be mounted both on the "normal" discharge line and on the line directed to the underground tank. In rainy conditions without diesel loading operations, water flows towards the line up to the oil separators present before the detention basins, and the line towards the diesel tank will be closed.

11 In addition to this system (which only manages accidental spills), all rainwater discharged onto the yards and roads will be treated with continuous oil separation systems before being discharged into the detention basins and then into the ditch.

12 There will be no spring closure systems or other mechanisms in case of power failure to the valves. Instead, it will be possible to unlock the servomotor and manually operate the valves if necessary.

6.4.5 Lamination tanks

01 For the design of MIL08A in order to comply with the principle of hydraulic invariance, two lamination tanks will be constructed, one located north of the building and the other south of the building.

6.5 Sprinkler and fire hydrant systems

01 Firefighting external system will be provided with two different pehd pipe networks, one for the sprinkler system and one for the hydrant system that will make a ring around the campus.

02 There will be a dedicated supply point connection from municipality for fire protection systems (sprinkler and hydrants).

03 In order to follow NFPA regulations that require a maximum tank filling time of 8h and considering that from the municipality the minimum guaranteed pressure is 1.5/2bar, the volume of firefighting water was increased by doubling the calculated minimum value.

6.6 Telecommunications

6.6.1 Fibre Service General

01 The Contractor shall negotiate, manage and co-ordinate the provision of a new incoming telecommunications service to the site by the supply authority to be carried out by local carriers. This telecommunications service is for the sitewide services; the Data Hall incoming telecommunications services shall be procured by the tenant / client.

02 The Contractor shall liaise and advise the employer on the appropriate incoming telephone service and number of lines, including where necessary provision for the lifts, and external 24/7 monitoring facility, along with requirements to suit the employer's operational needs.

03 Allow for separate discussions with an alternative telecoms/ fibre service provider and arrangement of separate service where required by the employer. Where the Employer has no requirement ensure provision of separate spare duplicate ducts to enable future installation.

04 Refer to civil design for details of the underground ducts to be provided.

6.6.2 Fibre Service Specific

01 Allow to liaise with a local carrier to provide four independent services to the site terminating on site as shown.

02 As detailed on the drawing allow to provide four carrier neutral provisions for the site. The contractor shall install, design and coordinate the entire onsite fibre duct bank network and all manholes, pits, chambers and receiving rooms (MMR and POE).

03 The duct bank network shall run to the site boundary where the service hall terminates in a suitable fibre boundary chamber. This chamber is for onward connection to the external fibre incoming duct network.

04 The contractor shall provide suitable chambers for the four potential services and locate these within 450 mm of the boundary.

05 The contractor shall then diversely route the fibre ducts from the entry points to the MMR and POE rooms located in the building. There will be 2no. POEs provided and 2no. MMRs per building.

06 There is a requirement of 20 m separation between each of the diverse fibre routes, including from the boundary to the point of termination internally, and onwards to the Data Halls.

07 Terminate fibre ducts 450 mm above the floors in the POE and MMR rooms.

08 The fibre services terminate directly into the POE and MMR rooms. The incoming fibre ducts must be continuous and segregated from the zero manhole to the POE and MMR and shall connect to these rooms via a pull room or other interceptor.

09 The Contractor will be aware of the high-water table of the project and the surrounding 'Biotope', the Contractor shall be responsible for providing all water abatement measures including water sealing, anchoring of the services and tree root resistance to ensure that the internal of the duct remains water free, the duct is held into position and are not at risk from damage from tree roots.

10 The minimum bending radii of any telecommunications duct is 1000mm, including the associated draw pits. The design shall generally allow for the use of 50mm OD fibre optic cable, with a bending radii not less than 20 x diameter (1000 mm).

6.7 Gas Supply

01 No gas provided to the site.

6.8 Electrical Supply

01 The specialist substation and electrical utility contractor is providing a full turnkey provision to provide a dual redundant 22kV supply to the site. The works contract includes land purchase, cabling, builder's work, design, construction of the substation and the provision and testing of all equipment to provide a dual 22kV supply to the site.

02 The specialist substation and electrical utility shall provide all trenches from the 132 kV primary substation to the boundary and beyond, and a trench from within the substation to the outside.

03 The Contractor shall be responsible for coordinating the incoming utility service trench, as well as providing the trench/duct provision between the substation and the buildings.

04 The 22kV terminations of the 220kV/22kV transformers switchgear form the line of demarcation between the local substation turnkey package contract and the contractor's responsibility. The Contractor will be responsible for managing the interface and completion of the cable connection to the building, presenting the 22kV cables to the MV switchboard in substation and providing site welfare facilities for the transformer vendors. The contractor is to allow for terminating the 22kV cables on the substation switchboard.

05 The contractor shall be responsible for the design of all control, auxiliary and protection cables between the substation MV switchgear and the building level 22kV switchgear, as detailed in the project documentation.

06 The contractor shall be responsible for the provision of all necessary attendance to the specialist substation contractor if required.

07 The Contractor shall be responsible for cable duct routes from the substation to the buildings.

7.0 EXTERNAL ELECTRICAL SERVICES

7.1 General

01 The external electrical services shall be supplied by a network of buried ducts around the site, which shall be coordinated by a specialist civil engineer, employed by the contractor. Refer to the civils drawings and documentation for further details.

02 Due to the large nature of the site, the general lighting and security services shall be supplied by a series of feeder pillars. Feeder pillars will be protected against direct vehicle hit by protective bollards.

03 Feeder pillars shall house distribution boards to power the external lighting and security services (CCTV). In addition to surge protective devices, time clocks and contactors for the lighting control.

04 An integral battery system shall be provided to the feeder pillars to supply the CCTV cameras, to maintain continuous supply to the CCTV services during a power outage. The autonomy shall be 5 minutes.

05 The distribution boards within the feeder pillars shall be supplied from 63A TP&N MCBs within the internally located external lighting distribution boards, via buried ducts.

06 The protective devices, from the final circuit MCB in the feeder pillars through to the source shall be selected to ensure that protective device selectivity is achieved.

07 Feeder pillars shall be double panel IP65 construction:

1. To be finished in a standard RAL colour – to be confirmed by the Architect;
2. Shall be sized to accommodate the equipment as necessary to support the external services;
3. To be installed on concrete plinth;
4. Incoming ducts shall be appropriately sealed on entrance to feeder pillar to prevent ingress of water and to maintain IP65 rating.

7.2 External Lighting

01 The Contractor shall provide a complete external lighting installation as per the Tender drawings, incorporating all luminaires, circuit distribution and associated controls as necessary to provide sufficient illumination for wayfinding and security purposes.

02 The external lighting design shall adhere to the ILE guidance notes for the Reduction of Obtrusive Light and local authority requirements.

03 The Contractor is responsible for undertaking the external lighting design to meet the planning requirements and compliance with relevant codes of practice. Compliance shall be demonstrated with external lighting calculations, using a leading lighting calculation software package (such as Dialux or Relux) for Black & White Engineering review.

04 The external lights shall generally be supplied from a series of external lighting distribution boards, strategically located internally around the perimeter of the building.

05 External lights mounted on the building façade shall be supplied directly from the internal distribution boards via surface mounted galvanised steel conduit and HEPR/LSZH type cables in accordance with local requirements. These shall be controlled with respect to time by contactors and timeclocks within the distribution board housing, and with respect to daylight through integral photocells.

06 External free-standing pole mounted luminaires away from the building shall be supplied from external lighting distribution boards housed within the feeder pillars, via buried ducts. Cabling to be HEPR/SWA/PVC type, generally from a 10A Type C MCB.

07 The indicative duct and proposed circuit routes for the external lighting have been shown on L22's civil drawings.

08 External free-standing luminaires shall be controlled by integral photocell and timeclock with contactors located within feeder pillars.

09 Allowance shall be made for manufacturer's recommended columns for free-standing luminaires.

10 Allowance shall be provided for lighting circuit to entrance for future lighting to feature statue and advertisement signage.

11 In outdoor areas, the average lighting values must be calculated in compliance with UNI EN 12464-2 standards and the end user requirements.

Environment	Average Lighting Value	Note
External Walkways	30 lux	
Parking areas	20 lux	
Vehicle Entry/exit points	30 lux	
Loading dock	50 lux	30lux when not in use

12 Exterior lighting during the hours of darkness will be a minimum of 1 foot-candle (fc) or 10 lumens per square meter (lux) in usable areas except the specific areas noted in the table above. Exterior lighting must not be on a switched circuit.

7.3 EXTERNAL SECURITY

7.3.1 Requirement

01 The Contractor shall provide a complete external security CCTV installation and access control system, incorporating all CCTV cameras, mounting poles, network switches, network cabling, power supplies and access control intercoms/proximity card readers for at the external gate.

02 For the quality and workmanship requirements for security systems, refer to Black & White Project Documents and the wider security section outlined herein.

7.3.2 External CCTV

01 Cameras installed to the façade of the building shall be supplied from the external security network switches and internal distribution boards where appropriate (for example pan tilt zoom cameras, or where distances exceed the capabilities of PoE).

02 Indicative camera selections have been outlined on the sitewide 67 series drawing, however it will be the Contractor's responsibility to design the system to the relevant standards and the Client's requirements.

03 Particular attention shall be paid to the biotope, which may prohibit the view of cameras. The Contractor shall coordinate with the landscape architect, to ensure the external CCTV systems provide full detection / view of the site perimeter.

04 The CCTV equipment manufacturer will be Axis, all external cameras will have the Axis E rating. The Contractor shall ensure that all cameras are suitable to endure adverse conditions of the external environment, such as IP65 rating and protection against cold temperatures.

05 The entire perimeter fence line shall be monitored by thermal imaging cameras, to ensure that the perimeter is captured during all light conditions. The Contractor shall develop the external security design with respect to the biotope and foliage in the area.

06 In addition to the perimeter defence, strategically placed non-thermal cameras shall be provided covering key aspects of the site, including but not limited to the below:

1. Main entrance in and out;
2. On the perimeter corners aiming towards the building;
3. Wide angled cameras on the perimeter aiming towards the building;
4. The substation;
5. The main carpark.

07 Infrared LED illuminators shall be provided for all external cameras to assist with image capture in low-light conditions.

08 Due to the large nature of the site, the external CCTV around the site shall be supplied from the external feeder pillars.

09 The fibre shall be extended to each CCTV camera, for the internal MMR.

10 A 5A power supply fed from the feeder pillar distribution board to each external camera shall be provided in all cases due to the length of run and camera requirements.

11 All exterior cameras shall ensure high quality pictures in low lighting scenarios.

12 Any camera mounted on a pole or mounted in a location with the increased possibility of vibrations/movement.

7.3.3 External Access Control

01 The MEP Contractor shall provide access control to be provided to the external security gate and gaurdhouse, as shown on the drawings. Refer to the Security responsibility matrix in the Appendices.

7.4 External Power

7.4.1 Requirements

01 The Contractor shall provide a network of external power to electrical support the security systems, drainage and life safety systems.

02 Power shall be provided to the fire hydrant pumps, and pumping stations.

03 In addition to the above, the Contractor shall make necessary allowances for power provisions for sump pumps to each of the buried power and fibre draw pits both internally and externally.

04 For the quality and workmanship requirements for small and fixed power systems refer to Black & White Project Documents and the wider security section outlined herein.

05 The power for security shall be derived from the external distribution boards located within feeder pillars via the network of buried ducts and shall terminate directly into the CCTV pole or in an IP67 rated adaptable box. All external final circuit cabling shall be XLPE/SWA/PVC.

7.4.2 Surface Water Pumps

01 Provide a series of IP67 power supplies to the run and standby surface water pumping stations as specified within the Project Documents.

02 Supplies shall be derived from internal final circuit distribution boards, cables shall be XLPE/SWA/LZ0H type supplied in dedicated 100mm ducts.

03 The Contractor shall arrange for the surface water pumps to be connected and monitored on the BMS network.

7.4.3 Security Services

01 The Contractor shall provide a network of small and fixed power to supply the CCTV and access control equipment externally.

02 For the CCTV cameras, a 5A power supply fed from the feeder pillar distribution board to each external camera shall be provided in all cases due to the length of run and camera requirements.

03 For access control, the Contractor shall provide IP67 power supply as required to support the external access-controlled gates, and the audio/visual intercom equipment.

8.0 FIRE & LIFE SAFETY STRATEGY

01 the administrative process will consist of submitting the project evaluation (60 days for approval; the realised project must follow what has been sent to the fire brigade command) and derogation (90 days for approval; it is sent altogether with the project evaluation) to the fire brigade command and then, once the construction site is completed, the SCIA VVF will follow, in order to start the activity. Subsequently, an inspection visit will be carried out by the Milan fire brigade to issue the CPI.

02 The following activities subject to Presidential Decree 151/2011 are configured within the site:

1. No. 1 activity 64.2.C “Centri informatici di elaborazione e/o archiviazione dati, con oltre 50 addetti”;
2. No.17 activity 49.3.C for MIL08A “Gruppi per la produzione di energia elettrica sussidiaria con motori endotermici ed impianti di cogenerazione di potenza complessiva > 700 kW.”
3. For the design of the buildings suitable for hosting all activities related to the Data Center, the application of Ministerial Decree 03.08.2015 as amended (Fire Prevention Code) is envisaged. For power generators, reference is made to Ministerial Decree 13.07.2011 and Ministerial Decree 28.04.2005.

03 It is considered a Risk profiles:

1. Rvita A3 for the macro-compartments “Data Hall” where there are Data hall, IDF, Power module, MEP Gallery and electrical corridors.
2. Rvita A2 for the macro-compartment “Offices” where I can find offices, storages, some technical rooms, loading bay. Offices occupancy must be maximum 0,1 pp/sqm
3. Rbeni = 1

4. Rambiente not significant

04 Since a sprinkler system is provided within all compartments of the building, the risk profile can be reduced to A2 for Data-Hall and A1 for Offices leading to some advantage for the travel distances (Les and Lcc). The maximum length of the escape route is different among the two Rvita:

05 Data-Hall (A2):

Les = 60 m + 25% = 75 m

Lcc = 30 m + 25%= 37,5 m

06 Offices (A1):

Les = 70 m + 15% = 80,5 m

Lcc = 45 m + 15%= 51,75 m

07 The fire strategy, according to the fire load of these compartments, provides:

08 REI/EI60 fire rate for the structures and partitions of the entire building (as shown in the drawings). Roof and the other horizontal structures must be at least REI60 fire rated in order to have a delay of the spreading fo the fire even if they are not considered compartments.

09 Smoke-proof filters in between the communication of Data-Hall and Offices must be provided following UNI 12101-13. This layout led us to provide a smoke-proof staircase that is an advantage as a safety measure.

10 Technical rooms and storages within single compartments and whereas possible having them maximum of 25 sqm to avoid smoke extraction.

11 Fire control measures by external column hydrants UNI 70, internal fire hoses UNI 45, fire extinguisher and sprinkler system for all compartments (dry fire hoses will be provided for the macro compartment “Data Hall”).

12 Automatic fire detection and alarm system for the entire building with EVAC system

13 Emergency lighting with ≥ 1 lux must be provided following the UNI 1838 and must be extended in the external areas too leading to the safe place

14 Natural smoke and heat control for the offices compartments must be provided through the use of openable window and it’s required to be at least 1/40 of the compartment’s area. For DM 03/08/2015 it’s possible to provide automatic windows which open just in case of fire. Where it’s not possible to have natural smoke and heat extraction it’s required a mechanical system (ref. UNI 9494-2 appendix H). It is possible to avoid smoke and heat extraction if the compartment is 25 sqm or less and has 600 MJ/sqm fire load (or less) or if the compartment is under 100 sqm and the fire load is 200 MJ/sqm or less. For this reason, compartments of 25 sqm are recommended.

15 Fire load in filters, smoke filters and “safe” compartments must be 50 MJ/sqm or less

16 Materials’ fire reaction must be GM3 for internal and external use. There are some portion of the facade of 100 cm which will have A2-s1, d0 fire reaction. For the roof it is required to be Broof(t2) standard for external fire reaction.

17 The first floor must be provided with a safe space for disabled people of 1,77 sqm of dimension, located near by the staircase. The safe space is indicated by signage and it’s equipped with bidirectional communication, rules dashboard and evacuation chair

18 The building is equipped with an emergency management centre which entrance is reachable through and external door. It contains:

1. EPO buttons and electrical schemes;
2. access and doors control
3. Smoke extraction panel
4. EVAC microphone and interphone to communicate with the safe space,
5. CCTV
6. Remote control of the alarm system

19 All external staircases reach the roof and provide emergency options for the escape route and all the final exit open in the sense of the travel and doors are provided with a pushbar.

20 Regarding PV Panels, the project is following the guide lines prot. N. 1324 of 07.02.2012 and RTV13. It's recommended to have class I fire reaction panels. They must be set upon an REI60 and Broof(t2) slab.

21 Power modules have access through internal corridor, compartmented into EI60 containers. It is considered internal to the building, is the need of the EI60 compartment. All of the fire protection elements that are provided inside the data centre building must be replicated into the power modules (sprinkler, EVAC, fire alarm button, smoke and heat detection, fire extinguisher, emergency lighting). The need of smoke extraction depends in the specific fire load calculations (Qf). The requirements to the smoke extraction must follow the guidelines for the performance level II of measure S.8. - UNI 9494:2 appendix H for the sizing of the system. If the fire load is lower than 600MJ/m2 and the surface is under 25 sqm, there is no need for the smoke extraction.

22 Inside the complex, 17 generators for MIL08A, each equipped with its own built-in tank with a capacity greater than 25 m3 installed underneath the generator. The generators are installed in an open space as defined by Ministerial Decree 30.11.1983. The purpose of this technical report is to highlight compliance with the fire safety standards and technical criteria for the construction of the generators located on the ground floor, externally to the building, where it rains. According to the DM 11 July 2011, the classification is 'placed externally to the building'. Genset must respect an offset of 300cm deep everything must be at least A1 fire reaction class. In this area of 3 meters it's forbidden to have anything that can be hazardous for the GE.

23 Point 3.2 – Section II, Chapter II – Title I of the Ministerial Decree of 13 July 2011 "The capacity of the built-in tank cannot exceed 2,500 dm3 in the case of fuel with a flash point equal to or greater than 55 °C"

24 Point 6.2, letter a – Title VI of the Ministerial Decree of 28 April 2005 "100mc, for fuel deposit located externally to the building"

25 Point 2, Capo II – Title II of the Ministerial Decree of 13 July 2011 "The groups and/or cogeneration units must be surrounded by an area with a depth of no less than 3 m free from materials or vegetation that could constitute a fire hazard"

9.0 MEP SERVICES DESIGN CRITERIA

9.1 General

01 The following sets out the high-level design criteria for the data centre facility.

02 It shall be noted that this project is not designed on the basis of gaining UTI or TIA accreditation. However, the basis of the design is to provide a 'concurrently maintainable' installation and follows the principles of good engineering practice as set out by Uptime Institute.

03 Spatially, the access corridors to the data halls shall be designed and coordinated to allow the transportation of Maximum Rack Dimensions 600mm (W) x 1380mm (D) x 2600mm (H). The Contractor shall allow 100 mm for the rolling aids.

04 The maximum IT capacity for the building has been agreed at 20MWe (IT).

9.2 Drainage

9.2.1 Codes and Standards

Reference	Description
STACK BOD V P01	Stack EMEA European Reference Design
CIBSE	Guide G: Public Health and Plumbing
AWWA	American Water Works Association
ASPE	American Society for Plumbing Engineers
EN 12056-2	Gravity Drainage Systems within Building Part 2: Sanitary pipework, layout and calculation.
EN 12056-3	Gravity Drainage Systems within Building Part 3: Roof drainage, layout and calculation.
IOP	Institute of Plumbing Guidelines
Local Codes	Refer to section on Local Standards

9.2.2 Design Criteria

01 The wastewater flow rate to be calculated using the formula stipulated in BS EN 12056 – Part 2. A typical frequency factor (K) of 0.5 value to be considered for intermittent use for an office.

$$Q_{ww} = K\sqrt{\Sigma DU}$$

where:

Q_{ww} = Waste water flowrate (l/s)
K = Frequency factor
ΣDU = Sum of discharge units

02 Other continuous flow/pumped flow rates shall be added separately where applicable.

03 Calculation of appliance and sanitary fixtures drainage discharge shall be based on the drainage discharge units (DU) of system II, stated in table 2 of BS EN 12056 – part 2.

Sanitary Fixture	Discharge units
Wash Hand Basin	0.3
Sink	0.6
Water Closet	2.0

Shower	0.4
Dishwasher	0.6

9.2.3 Foul & Waste

01 Gradient falls for the black water system shall be designed to 1:100 or 1%.

02 The size of the sanitary fitting outlet connection installed within the sanitation system shall not be less than the minimum shown in the table below.

Sanitary Fitting	Outlet Size (mm)
Wash Hand Basin	32
Sink	40
Water Closet	100
Shower	40
Dishwasher	40

9.3 Water Supply

9.3.1 Codes and Standards

Reference	Description
STACK BOD V P01	Stack EMEA European Reference Design
CIBSE	Guide G: Public Health and Plumbing
AWWA	American Water Works Association
ASPE	American Society for Plumbing Engineers
EN 806	2010 Specifications for conveying potable water
HSE UK: 1998	Safety in the installations and use of gas systems and appliances
IOP	Institute of Plumbing Guidelines
Local Codes	Refer to section on Local Standards

9.3.2 Design Criteria

01 Domestic water flow rates to be based upon UNI9182 guidelines, loading units to be as per indicated in the below table.

Appliance	Loading Units Cold	Loading Units Hot	Total Loading Units (Hot+Cold)
WHB	1.5	1.5	2
Sink	3	3	4
WC(Cistern)	5	-	5

Appliance	Loading Units Cold	Loading Units Hot	Total Loading Units (Hot+Cold)
Shower	3	3	4
Bib tap	6	-	6
Dishwasher	4	-	4

02 In line with UNI9182, all fixtures to be selected based on maximum allowable flow rates provided in the following table.

Fixture	Flow rate (At 3Bar)	Minimum Working Pressure (Kpa)
Wash Basin	< 0.1 l/s	100
Shower head	< 0.15 l/s	100
Toilet	< 0.1 l/s	100
Sink	< 0.15 l/s	100

03 The domestic water pipework shall be designed in as per below.

Service	Pipe Diameter (mm)	Max. Pressure Drop (kPa/m)	Max. Velocity (m/s)
H&CW supply	DN15 – 65 DN75 and above	0.5 -	- 2.0
HW recirculation	All	0.5	-

9.3.3 Cold Water Supply

01 The domestic water installation consists of a packaged booster pump set with a break tank and a distribution pipework to the various appliances delivering water at a pressure of 1.5 – 2.2Bar.

9.3.4 Hot Water Supply

01 Hot water storage and distribution temperatures of 60°C and 55°C respectively.

9.4 Fuel System

9.4.1 Codes and Standards

Reference	Description
STACK BOD V P01	Stack EMEA European Reference Design
UL 142	Steel Aboveground Tanks for Flammable and Combustible Liquids
UL 2085	Protected Aboveground Tanks for Flammable and Combustible Liquids
API 5L	Line Pipe

UL 971	Non-metallic Underground Piping for Flammable Liquids
NFPA 30	Flammable and Combustible Liquids Code
Local codes	Refer to section on Local Standards

9.4.2 Design Criteria

01 The project shall fully comply with local regulation and standards. A concurrently maintainable fuel oil storage and distribution system shall be provided for 48 hours autonomy at full load with the N generators operating.

02 Each generator to have its own bulk fuel storage and day tank with a total storage duration of 48 hours. The storage tanks to be belly tanks, fuel type to be a high-grade light diesel.

03 Connections for mobile fuel polishing unit shall be provided.

04 Fuel system shall be provided with redundant control and monitoring systems. Leak detection system shall be capable of detecting leakages and interfaced with building automation system (BAS).

9.5 Cooling

9.5.1 Codes and Standards

Reference	Description
STACK BOD V P01	Stack EMEA European Reference Design
ASHRAE	90.1
ASHRAE	62.1
ASHRAE	Fundamentals Handbook
ASHRAE TC9.9	Thermal Guidelines for Data Processing Environments
CIBSE	Guide A & C
NFPA	National Fire Protection Agency
Local Codes	Refer to section on Local Standards

9.5.2 Ambient Design Conditions

01 The ambient design conditions have been based on Milano Linate, Italy.

Weather Station: MILANO LINATE, ITALY (WMO: 160800)		
Description	Criteria	Remarks
Space Cooling - Critical Spaces		

Weather Station: MILANO LINATE, ITALY (WMO: 160800)			
	Dry Bulb	37.9 °C	ASHRAE N=20 + allowance to be made for global warming and hot air recirculation. As per CFD report, chillers shall be selected at 44°CDB ambient temperature. The final CFD analysis to be determined by the contractor.
	Wet Bulb	28.7 °C	ASHRAE N=20
Fresh Air - Critical Spaces - Cooling & dehumidification			
	Dry Bulb	37.9 °C	ASHRAE N=20
	Wet Bulb	28.7 °C	ASHRAE N=20
Space Cooling - Non-Critical Spaces			
	Dry Bulb	33.7 °C	DB@ 0.4% Annual Cooling
	Wet Bulb	23.8 °C	WB@ 0.4% Annual Cooling
Fresh Air - Non-Critical Spaces – Cooling & dehumidification			
	Dry Bulb	33.7 °C	DB@ 0.4% Annual Cooling
	Wet Bulb	23.8 °C	WB@ 0.4% Annual Cooling
Space Heating & Fresh Air - Critical Spaces			
	Dry Bulb	-10.1 °C	ASHRAE N=20
	Relative Humidity	100% SAT	
Space Heating & Fresh Air - Non-Critical Spaces			
	Dry Bulb	-4.0°C	DB@ 99.6% Annual Heating
	Relative Humidity	100% SAT	
Fresh Air – Critical & Non-Critical Spaces - Humidification			
	DP	-11.1°C	Dew point, ASHRAE 99.6% Annual Humidification
	HR	1.5 g/kg	Humidity Ratio, ASHRAE 99.6% Annual Humidification

02 Chillers must provide sufficient cooling capacity to deliver 100% of the required cooling & IT load at the worst-case design condition with generators operating.

03 For walls, windows and roof U-values, Contractor to refer to architectural data/sections.

9.5.3 Indoor Design Conditions

01 Indoor design conditions are based on the below requirements coupled with best engineering practice and industry standards for the various space uses.

Area	Classification	Internal Design Conditions
Data Halls + IDFs	Critical	• 5% - 80% Relative Humidity between 10°C - 35°C DB (non-condensing) • Supply Temperature: 26°C. • 13.9°C rise across IT servers based upon 59.5 l/s per kW.IT. • 10°C maximum rate of temperature change per hour. • 20% maximum rate of humidity change per hour.
Battery Rooms	Critical	• Li- Ion Batteries. • Room temperature: 26±2°C. • 5% - 80% RH, non-condensing (no RH control provision). • Room internal design conditions to comply with manufacturer's recommendation if more onerous. • DX Cooling (N+1), part of the power module.
Electrical Rooms / IT & Mech Power Modules	Critical	• 16°C - 35°C DB, 5-80% RH, non-condensing (no RH control provision). • Supply air temperature: 26°C. • Max 30°C at UPS air intake, UPS return air to be ducted to the CRAH units. • Room internal design conditions to comply with manufacturer's recommendation if more onerous.
MMR / POE		• Supply air temperature:26°C. • 80% RH Max, non-condensing (no RH control provision).
Facility Support Areas	Essential	• 24±1 °C DB
Occupied Administrative Areas	Non-Critical	• Circulation – 24°C ±2°C • SOC/ FOC – 22°C ±2°C, 20-70% RH non condensing • Meeting rooms - 22°C ±2°C, 20-70% RH non-condensing • Other administration areas - 22°C ±2°C, 20-70% RH non-condensing 20-70% RH non-condensing • Local requirements shall take precedence if more onerous.
Mechanical Plantroom	Essential	• 16°C - 30°C DB

Area	Classification	Internal Design Conditions
Storage Areas	Non-Critical	• 10°C - 35°C (no RH control provision)

02 Equipment heat gains from CRAH units, busbar, UPS systems, transformers, switchboards, batteries and all other heat generating plant and equipment shall be determined as part of the Contractor's detailed design based on actual equipment selected.

9.5.4 Chilled Water Pipework Sizing

01 Chilled water distribution network shall be fully concurrently maintainable with diverse routing that is achieved via vertical risers and cross main connections serving FWUs and CRAHs.

02 All chilled water pipework shall be thermally insulated and where at risk of damage Contractor to provide additional protection.

03 The chilled water system shall operate at 21/31°C flow and return temperatures. The CDU technology side flow chilled water temperature shall not exceed 26°C in line with the customer requirements.

04 Chilled water pipe works design criteria is as listed in below table.

Operation Mode	Max Velocity	Max Pressure Drop
Normal	3m/s	300Pa/m
Failure	5m/s	450 Pa/m

9.6 Ventilation System

9.6.1 Codes and Standards

Reference	Description
STACK BOD V P01	Stack EMEA European Reference Design
ASHRAE	90.1
ASHRAE	62.1
ASHRAE	Fundamentals Handbook
ASHRAE TC9.9	Thermal Guidelines for Data Processing Environments
CIBSE	Guide A & C
NFPA	National Fire Protection Agency
Local Codes	Refer to section on Local Standards

9.6.2 Data Hall Pressurization

01 Data hall to be pressurized via roof-top fresh air handling units (FAHU) that consists of filters, mixing box, DX cooling/heating coil, reheat coil, supply and extract air fans.

02 The data hall FAHU's to be designed to provide pressurization of +12.5Pa pressure differential to adjacent spaces assuming average construction or code required minimum outside air, whichever is greater.

03 FAHU's to be designed to control relative humidity within data hall and keep it within the acceptable range of 5%-80% RH.

04 Data halls to be provided with supply air ducts and pressure relief dampers mounted on the wall facing surrounding corridors, return air ducts to be installed within surrounding corridors.

05 Motorised fire smoke dampers and fire dampers to be provided to ensure the integrity of the fire compartmentation as per FLS requirements.

06 Fresh air inlet to be equipped with smoke detector to shut-down the unit, close inlet dampers and raise an alarm in case of fire.

07 Supply and return air ducts shall be provisioned with sound attenuators to mitigate the noise internally through the distribution network. Intake and exhaust ducts to be provided with sound attenuators to mitigate the noise externally.

08 The following criteria to be used for the duct sizing.

Duct Selection	Max Pressure Drop (Pa/m)	Max Duct Velocity (m/s)
Final Connections	0.8	3
Main Branches	0.8	5
Main Risers	0.8	7

9.6.3 Admin Building Ventilation

01 Occupied spaces such as offices shall be maintained under positive pressure while toilets are at negative pressure, storages are kept neutral.

02 The FAHU serving the offices, storages, corridors and electrical rooms inside the admin block to have supply fan, filters, heat recovery function (thermal wheel), exhaust fan, VFDs, and a dedicated air-cooled heat pump that will be used for both cooling and heating.

03 Toilets to be provided with a dedicated air handling unit to avoid mixing return air from these spaces with supply air discharged into occupied spaces, the unit consists of bag filter, panel filter, frost coil, plate heat exchanger (sensible heat recover without mixing), DX heating/cooling coil, supply and return fans.

04 The following criteria to be used for the duct sizing.

Duct Selection	Max Pressure Drop (Pa/m)	Max Duct Velocity (m/s)
Final Connections	0.8	2
Main Branches	0.8	4
Main Risers	0.8	6
Terminal Unit - FCU	0.8	≤2.5

9.6.4 Standalone Spaces Ventilation

01 Fire pump room, valve rooms within the equipment yard and chilled water ancillary rooms to be provided with mechanical ventilation system that consists of supply air fan and exhaust louver. The rooms shall be maintained under positive pressure with minimum ventilation rate of 2ACHs.

02 Ventilation system within generator container shall be designed and installed by Vendor. Generator containers shall be provided with exhaust hood, and the flues shall be extended 1m above the hood level. Both exhaust hood and flue are vendor scope of work. However, the support/steel work shall be provided by the general Contractor.

03 Ventilation system for the power modules shall be provided by the vendor. Each power module (LV and MV section) shall be provided with dedicated ventilation system. Power modules shall be maintained under positive pressure with minimum ventilation rate of 2ACHs.

04 Relative humidity shall be maintained within the acceptable range of 5-80%, fans shall be linked to temperature and humidity sensor to switch them off in case ambient conditions were not within the acceptable range.

9.6.5 Filtration Design Criteria

01 Contractor to comply with the below filter type for the selected equipment as a minimum requirement.

Equipment	Filter
Data Hall Fresh Air Handling Unit	MERV 8 (Pre-Filter) & MERV 13 (Final Filter)
Data Hall Fan Wall Unit	G4
Admin Building Fresh Air Handling Unit	F7 + F9
VRF Indoor Fan Coil Unit	G4

9.6.6 Equipment Resilience

01 The following system component redundancy to be considered.

Equipment	Redundancy
Data Hall – FAHU's	0.5N+0.5N per data hall with concurrently maintainable duct work distribution network
General Office Administrative Area - FAHU	N
Wet Area (Toilets) - FAHU	N

9.6.7 Smoke Control

01 Smoke control to be designed, installed and tested based on local code requirements and the project fire strategy report.

02 Data halls, technical spaces, electrical rooms, MMR & POE rooms, smoke filters and storage rooms larger than 25 square meters to be provided with smoke control.

03 Smoke extract ducts within data halls to be terminated with extract grill above ceiling void while make-up air to be provided below ceiling via supply diffusers.

04 Smoke fans shall be activated by the fire alarm system, only motorized smoke control dampers in that fire zone shall open during fire.

05 Smoke extraction and make-up air system shall follow requirements of UNI9494 and EN 12101-3 for fan sizing and EN 12101-7 for duct sizing.

06 Smoke filters to be provided with pressurisation fans to prevent smoke ingress in case of fire. The fan shall be sized based on EN 12101-13 to maintain a differential pressure of 30Pa max in relative to adjacent spaces.

07 The following criteria to be used for the duct sizing.

Duct Selection	Max Pressure Drop (Pa/m)	Max Duct Velocity (m/s)
Smoke	1	8-9

9.7 Fire Protection

9.7.1 Codes and Standards

Reference	Description
STACK BOD V P01	Stack EMEA European Reference Design
NFPA	National Fire Protection Agency
Local Codes	Refer to section 28

9.7.2 Design Criteria

01 The entire facility shall be provided with an automatic fire suppression system. The final design of the fire suppression system shall be in accordance with NFPA standards and all applicable European and local codes.

02 The design, installation, commissioning and certification of the fire suppression system shall be carried out by an approved specialist sub-Contractor as part of the project and construction team.

03 Hazard classification table for sprinkler system.

Area	Hazard Clarification	Suppression System
Data Hall	OH2	Pre-action System, Double Interlock
MEP Gallery	OH1	Pre-action System, Double Interlock
Data Hall Corridor, Filter	OH1	Wet Sprinkler System
Storage Room	Storage - Class I-IV	Wet Sprinkler system
Loading Bay, Staging Area	OH2	Dry Sprinkler System
IT Power Module	Extra Hazard Group 1	Pre-action System, Double Interlock

Generator	Extra Hazard Group 1	Pre-action System, Double Interlock
Mechanical Plant Room	OH1	Wet Sprinkler System
Electrical Room	OH1	Pre-action System, Double Interlock
Office Area, Admin Corridor, Toilet	LH	Wet Sprinkler System
SOC Office	OH1	Pre-action System, Double Interlock
SOC Storage	OH1	Pre-action System, Double Interlock
Fire Pump Room	Extra Hazard Group 2	Wet Sprinkler System

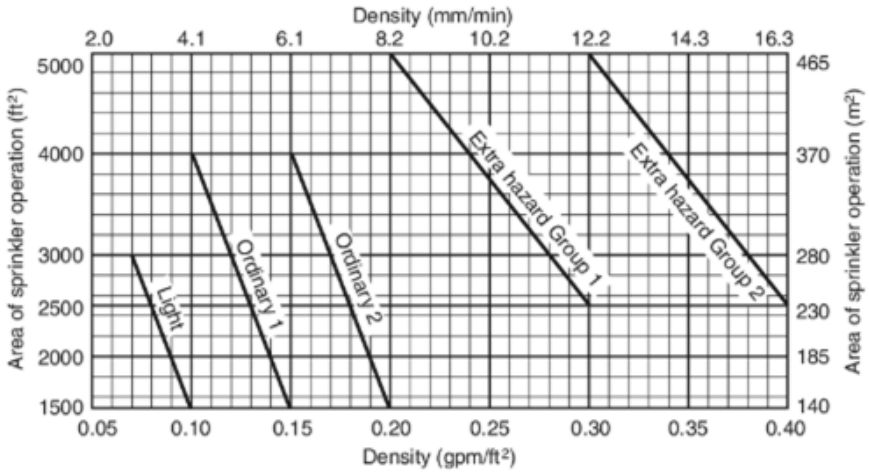
04 Sprinkler system shall be designed as per NFPA-13 to serve wet sprinklers, double interlock pre-action and dry pipe systems. Minimum operating pressure of any sprinkler shall be 0.5 bar.

05 A more detailed description for hazard classification to be followed.

Group	Sprinkler Design Criteria
Light Hazard	Maximum protective coverage area per standard sprinkler - Max coverage = 21 m², Spacing = 1.8 – 4.6 m Sprinkler zone for light hazard = 4,831m² Design density = 4.12 lpm/m² (0.10 gpm) Area of operation = 140 m² Hose stream allowance = 100 lpm Duration = 30 min
Ordinary Hazard (Group 1)	Maximum protective coverage area per standard sprinkler - Max coverage = 12 m², Spacing = 1.8 – 4.6 m Sprinkler zone for light hazard = 4,831m² Design density = 6.1 lpm/m² (0.15 gpm) Area of operation = 140 m² Hose stream allowance = 950 lpm Duration = 60 min
Ordinary Hazard (Group 2)	Maximum protective coverage area per standard sprinkler - Max coverage = 12 m², Spacing = 1.8 – 4.6 m Sprinkler zone for light hazard = 4,831m² Design density = 8.1 lpm/m² (0.2 gpm) Area of operation = 140 m² Hose stream allowance = 950 lpm Duration = 60 min
Extra Hazard (Group 1)	Maximum protective coverage area per standard sprinkler - Max coverage = 9 m², Spacing = 1.8 – 3.7 m Sprinkler zone area limitation = 3720m² Design density = 12.2 lpm/m² (0.3 gpm) Area of operation = 140 m² Hose stream allowance = 1900 lpm Duration = 90 min
Extra Hazard (Group 2)	Maximum protective coverage area per standard sprinkler - Max. coverage = 9 m², Spacing = 1.8 – 3.7 m

Group	Sprinkler Design Criteria
	Sprinkler zone area limitation = 3720m² Design density = 16.3 lpm/m² (0.4 gpm) Area of operation = 140 m² Hose stream allowance = 1900 lpm Duration = 90 min
Storage – Class I-IV (ESFR)	Maximum protective coverage area per standard sprinkler - Max. coverage = 9 m², Spacing = 1.8 – 3.7 m Sprinkler zone area limitation = 3720m² Number of sprinklers in design area = 12 sprinklers K factor = 240 L/min/ (bar)^2 Minimum operating pressure = 2.4 bar Hose stream allowance = 1900 lpm Duration = 60 min

06 The water demand for sprinklers shall be determined using the density/area curve from NFPA 13.



07 Fire protection system shall consist of two separate networks, each is provided with a dedicated pumping system that comprises of two diesel engine driven fire pumps (duty/standby) and 1 electric jockey pump.

08 The site to be provided with hydrant fire suppression via an underground loop in compliance with local code requirements.

09 Hydrant system to be designed as per local code UNI10779 to serve external and internal hydrants. Internal hydrants within critical spaces shall be connected to deluge valve system (dry network).

10 Power modules and generator containers that belong to the same phase to be served by the same pre-action valve.

11 A combined fire water storage tank shall be located externally within the service yard and sized adequately to serve sprinkler and hydrant networks. Main cold-water supply to be provided for the fire water storage tank filling. The water supply shall be capable of filling the minimum required fire protection volume within the tank in a maximum of 8 hours.

12 External pipes passing through unheated areas shall be insulated and trace heated.

13 Contractor to refer to Fire & Life Safety Strategy.

9.8 Noise Criteria

Data Halls	NR70
Open Plan Offices	NR38
Cellular Offices and Meeting rooms	NR38
Reception, Entrances and Corridors	NR40

9.9 Mechanical Equipment Resilience

01 The following system component redundancy to be considered.

Equipment	Redundancy
Chillers with integral CHW pumps	N+2
Buffer Vessels	N+2
Pressurisation units	N+1
Data Hall FWUs	N+2
Data Hall CDUs	N+1
Non-Data Hall CRAHs (MMR&POE)	N+1
FCUs serving critical spaces	N+1
FCUs serving non-critical spaces	N
Data Hall – FAHU's	0.5N+0.5N per data hall with concurrently maintainable duct work distribution network
General Office Administrative Area - FAHU	N
Wet Area (Toilets) - FAHU	N

9.10 Lighting

01 Lighting levels throughout shall achieve, but not exceed substantially illuminance levels outlined in UNI EN 12464 and the end user's requirements.

02 The lighting design shall achieve the requirements of the relevant design criteria and those set out below:

Area	Level	Plane	Comments
Offices	400-500 lux	Desk	
Plant Areas	200 lux	Floor	IP rated luminaries
Corridors	150 lux	Floor	Minimum 100lux
Staircases	150 lux	Tread	Minimum 100lux
Entrance/Reception	300 lux	Floor	

Area	Level	Plane	Comments
Loading Bay	250 lux	Floor	

03 Lighting levels as per end user requirements:

Environment	Average Lighting Value	Level of Reference	Comments
Data Halls/IDF	500lux	0.91m	
Other tenant leased spaces	250lux	0.91m	MEP Gallery/Tenant Storage etc.

04 In outdoor areas, the average lighting values must be calculated in compliance with UNI EN12464-2 standards and end user requirements.

Environment	Average Lighting Value	Note
External Walkways	30 lux	
Parking areas	20 lux	
Vehicle Entry/exit points	30 lux	
Loading dock	50 lux	30lux when not in used

9.11 Electrical Infrastructure Resilience

01 Critical electrical infrastructure shall be provided to facilitate concurrent maintainability of equipment throughout, as summarised in the following table and described in subsequent clauses:

Electrical Service/System	Redundancy Classification
Utility Supplies	2N
Substation MV Output Switchboards	2N
Primary Critical Substation Transformers	N+1 by reserve
Primary Critical Substation Generation	N+1 by reserve
Primary Critical Substation Essential LV Distribution	N+1 by reserve
Primary Mechanical Substation	5N/4
Essential Supplies to Mechanical Plant	N+1
Primary Critical Substation IT UPS	N+1 by reserve
Primary Critical Substation Generation	N+1 by reserve
Final Circuits to Data Cabinets	2N

9.12 OFCI Equipment

01 The following list summarises the plant classified as OFCI:

1. Power Modules.
2. Generators.

3. Air-Cooled Chillers (with integral pumps).
4. Fan Wall Units.
5. Cooling Distribution Units.

10.0 ELECTRICAL SYSTEMS

01 The building is separated into five discrete computer centres, which operate as completely separate data centres. As a strict permitting requirement, each of the computer centres must remain electrically separate and diverse.

10.2 MV Infrastructure

10.2.1 Incoming Utility Supply

01 The power supply will be from a new SSE 132/22Kv to be located within the campus.

02 22kV MV loops will subsequently be provided for each data hall from the 132/22kV substation, feeding the Ring main units (RMUs) in an open loop configuration.

03 The general Contractor shall coordinate the substation elements that are a part of their scope, which includes but is not limited to, earthing, civils, and drainage. The Contractor shall supply and install the 22kV MV cables from RMUs to the 132/22kV substation compound then strip, gland and prepare cables. The termination of the cables to the MV switchgear will be the responsibility of the HV D&B Contractor, with witnessing by both representation from both.

04 The Contractor shall review the requirements of the new utility supply to ensure the works are adequately coordinated.

05 All coordination responsibility relating to the incoming utility services shall be that of the substation provider.

06 The Contractor shall produce a full fault study analysis, including the MV and LV contribution, to prove that the fault level of all switchgear downstream of the substation is of suitable fault withstand.

07 The Contractor shall also produce a full protective device study, which shall include the protective devices from the source through to all end uses and shall ensure that full selectivity is achieved. This shall include full selectivity of all devices within the system, including UPS (fuses and inverters).

10.2.2 MV Distribution

01 The substation will be served by the public electricity network Terna via 132kV dual redundant feeders and will be stepped down to 22kV. The downstream RMUs will be served in an open loop configuration with each RMU feeding 1no. transformer. The Contractor shall install controls/signal cables between the RMUs and PowerCenter for MV/LV inter-tripping. One MV loop shall be supply two data halls, with either end of the ring originating in alternate MV boards in the EE substations.

02 The principal utility supplies are distributed through the facility (MIL08A) by means of 22 kV open rings, each in turn deriving its power from one of the two utility feeder switchboards.

03 The RMUs are located in the Power Modules.

04 MV cables supplied shall be in line with the requirement of the specifications and all local regulations.

05 Where MV cables are routed in underground ducts, the Contractor shall ensure adequate spacing in order to avoid the cables exceeding 90°C.

10.2.3 MV Switchgear

01 Each critical electrical power module will house the MV RMUs from which the power modules are fed. Each RMU shall be installed on a purpose-built steel plinth, the height of which shall be agreed with the power module supplier to allow for bending and terminating of the MV cables.

02 MV Switchgear shall be segregated from the rest of the LV infrastructure, by means of a dedicated separate room.

03 The Contractor shall note that busbar and circuit earthing is a required operational provision with respect to the selected MV switchgear. Suitable provision for preventing circuit/busbar earthing of an energised bus shall be provided and developed by the power module OFCI vendor (e.g. castell keys) and the contactor is to coordinate that installation.

04 The Contractor shall provide to the room statutory warning signs and also provide signage depicting the unique location and switch gear reference of the equipment housed with the cage.

05 The Contractor shall provide rubber matting in front of all MV Switchgear.

06 The open point in each MV ring shall be moveable manually, this shall be controlled by the operations team.

07 Transformer feeder circuit breaker operation shall be automatic and motorised, and staged with respect to limiting the transformer inrush characteristics.

08 Required MV switchgear performance characteristics have been described in greater detail in supporting project documentation.

09 Where unsynchronised sources have the potential to supply a common bus, such as the two utility supplies, an electrical interlock shall be provided between the circuit breakers to prevent paralleling (refer to project documentation). The requirements of the interlock shall be coordinated and agreed with the utility network operator.

10 The Contractor shall be responsible for conducting load flow, short circuit, selectivity and arc flash studies, throughout the system from the 132 kV to 22 kV to 400 V systems, using leading software such as ETAP or equivalent.

11 The Contractor shall be responsible for conducting Arc Flash and Arc Fault studies, throughout the system from the 132 kV to 22 kV to 400 V systems, with the output being a report recommending the required PPE levels.

10.2.4 132 kV / 22 kV Transformers

01 The 132/22kV transformers and associated substation works are to be provided as a direct separate contract to Stack.

10.2.5 Critical Power Modules Transformers

01 Critical Power Modules and the equipment contained within are to be provided by the Power Module Vendor.

02 The Contractor will be responsible for managing all interfaces with the Power Module supplier.

03 Each critical electrical system is supported by a dedicated power module.

04 Where rubber matting is not installed or provided by the power module supplier the contractor shall provide rubber matting where required around the power modules.

05 The Contractor is to ensure all arc flash requirements from the OFCI supplier are followed when installing all incoming/outgoing cables and associated services.

10.2.6 Control and Monitoring of MV Infrastructure

01 All cabling and containment for the installation of control, protection and monitoring cabling shall be by the contractor.

02 Refer to supporting project documentation for the BMS points list, and further detail on the control within the generator controls section.

10.3 PV Infrastructure

10.3.1 PV Infrastructure Installation

01 The Contractor is to be provide a complete PV installation for the site in line local requirements as indicated in L22 Photovoltaic report. The Contractor is responsible for the selection and erection of all of the PV equipment (panels, inverters and managers) and associated supports, fixings, cabling, containment, metering, relays to complete the installation. See CDP section for details that are expected as part of the PV design.

02 See the project documentation and L22 stage 3 PV report for the indicative layouts and associated routing that is to be developed by the Contractor.

10.4 LV Infrastructure

10.4.1 Critical LV Distribution

01 Critical LV distribution will be arranged in block redundant configurations, whereby each critical power module will support a portion of the load and dedicated FWUs and CDUs, such that in the event of a power module failure, the IT load and required FWU/CDU capacity is still supported.

02 A strict requirement is that the data centre remains fully operational (electrical and mechanical), at full load and worst-case design condition, following a completed primary electrical system failure. Only a single critical component failure must be accounted for whilst maintaining N redundancy.

03 Each critical power module will benefit from a transformer and switchgear as required to support the IT load and mechanical pumps.

04 MV/LV intertripping occurs between the main LV switchboard and the RMUs.

05 Dedicated IT UPSs will be provided to ensure there is continuous power to the tenant data hall racks.

06 Final distribution to the customer racks is via overhead busbars, is supplied on an A+B basis, from the PCS switchboards. Refer to Black and White's LV schematics for further details.

07 Although the design shall be in accordance with Tier III principles, rather than fault tolerant, the critical distribution associated with the IT load shall be arranged such that redundant services do not pass through the same fire compartment. Corridors and the Data Halls are exempt from this requirement.

1. Separate containment shall be provided throughout

08 The scope of supply under this contract is outlined on the schematics.

09 The critical power modules will additionally support a combination of critical cooling and landlord loads.

10 Please refer to supporting project documentation. All tariff metering shall be in accordance with local metering requirement standards, suitable for billing purposes.

11 The Contractor shall note that the expected loads shall be verified during the Contractor's Stage 4 design.

10.4.2 LV Switchgear

01 The contractor shall, provide and install all LV switchgear that is not part of the OFCI delivery with the required performance characteristics - the extent of which has been detailed in the project documents. The contractor shall only use those suppliers listed in the schedule of manufacturers contained in the ER.

02 25% spare capacity shall be provided in all small power and landlord / house systems. The 'spare' ways indicated on critical substation switchboards shall be accounted for spatially; however, equipping of these ways shall be agreed at the time of procurement to avoid a spare surplus.

03 The contractor shall clearly indicate within his proposal the available spare capacity (ways and switches) for each main switchboard and distribution board.

04 Where the contractor will provide LV switchgear all protective devices are to be the same manufacturer as the devices in the OFCI power modules.

05 The contractor shall be responsible for undertaking a comprehensive protection study and ensure selectivity and coordination of cascaded circuit protective devices for the entire LV system, including the power modules and all downstream equipment. Allowance for logic blocking, such as Zone Selective Interlocking (ZSI), shall be made on all devices equal to or exceeding 630 A. Where logic blocking is used, it shall be provided throughout the entire fault path for correct operation.

06 The protection settings for all devices shall be verified for mains operation, generator operation and UPS battery operation through a protection study.

07 The protection study shall include coordination with the UPS. The contractor shall be responsible for ensuring upstream and downstream coordination with the UPS inverter, internal bypass fuse and silicon-controlled rectifiers.

08 The contractor is to allow for three iterations of this report and associated modifications on site.

09 Where unsynchronised sources have the potential to supply a common bus, such as the UPS inverter output and mains, a castell interlock shall be provided between the circuit breakers to prevent paralleling as part of the OFCI power module scope. The contractor is to verify the correct operation of this system.

10 Additional unique key interlocking shall be provided to facilitate the transfer of UPS power to manual bypass, while preventing inadvertent paralleling of unsynchronised sources as part of the OFCI scope. See supporting project documentation for further details. The contractor is to verify the correct operation of this system.

11 Where rubber matting is not part of the OFCI scope the contractor shall provide rubber mats around all LV switchgear.

12 Within each switchroom the contractor shall provide laminated drawings showing the overall MV network and distribution system serving that particular switch room and associated LV switchgear together with a uniquely reference LV single line diagram of the particular system. The substation identification room and switchboard reference shall be clearly indicated on wall signage adjacent the schematics.

13 All LV switchgear circuit breakers over 630 A shall be withdrawable type. All circuit breakers equal or greater shall come complete with status lamps on the switchboard enclosure, for the following functions:

1. Open,
2. Closed,
3. Tripped.

14 All switchboards of 1250 A and above, shall come complete with arc flash reduction maintenance switches and a blue indicating light to indicate when the maintenance switch is activated. Following the Contractor's arc flash assessment, the settings when the maintenance switch is activated shall be determined.

15 The Contractor shall make allowances for primary injection testing at the factory for the Switchboard's ACBs & MCCBs (200A and above) as well as testing documentation upon completion.

16 All metering is to be provided in line with the project documentation, and shall be by the same manufacturer that is utilised in the power module.

17 All LV switchgear shall be provided with voltage presence indicators in the form of LED lights.

18 LV Cam lock panels are to be provided for load bank testing of the generators and UPS units. The cam lock panels are to have a minimum rating of 3200A/65kA for 1s for the generator and 3200A/50kA for 1s for the UPS units. The units will be floor standing, front and rear access if necessary for the generator and UPS connection.

19 The load bank will be connected to the power modules via IP67 cast-resin busbars, to be selected in accordance with local code.

20 The Cam lock panel is to be provided with CTs and relay to monitor the three phases individually and will operate the generator circuit breaker when an imbalance is measure in the phases.

10.4.3 Uninterruptable Power Supplies (UPS)

01 Static UPS technology shall be utilised throughout the scheme.

02 All services associated with the mechanical UPS, including the switchgear, cabling etc. shall be included as a separate item within the Contractor's tender return.

03 UPSs shall be high efficiency units (i.e. ≥99.2% …≥ @ 100% load). Each UPS unit shall be provided with its own internal static bypass switch per machine.

04 Each UPS system, either single units or multiple parallel units, shall be provided with a single external maintenance bypass rated to the full capacity of the system.

05 UPSs shall monitor the battery string voltage and current and automatically adjust the charging accordingly. The UPSs shall also be capable of temperature compensated battery charging via temperature sensors located within each battery room.

06 UPS units, along with UPS output panels, shall be located within cooled rooms.

07 UPS systems will not be synchronised between substations.

08 IT and landlord/life safety UPS systems will be provided as part of the critical power module OFCI.

10.4.4 IT UPS

01 IT UPS systems will be provided as part of the critical power module OFCI.

02 UPS's will be high efficiency units (i.e. >96% …≥ @ 100% load). Each UPS unit will be provided with its own internal static bypass switch per machine.

03 Each UPS unit will be provided with a single incoming and outgoing cable feed. The rectifier and internal static bypass switch (SBS) input paths will be connected within the UPS.

04 Each UPS system, either single units or multiple parallel units, will be provided with a single external maintenance bypass rated to the full capacity of the system.

05 UPSs will monitor the battery string voltage and current and automatically adjust the charging accordingly. The UPSs will also be capable of temperature compensated battery charging via temperature sensors located within each battery room.

06 UPS units, along with UPS output panels, will be located within cooled rooms.

07 Although the current design intent describes the use of 'modular' UPS systems will be considered, especially where low day 1 loads are expected, and the scalable nature of modular UPSs provide good day one capital expenditure efficiencies.

08 UPS systems will not be synchronised between substations.

09 Reference should be made to the UPS schedules and plant specification for further requirements associated with the UPS system.

10 UPS units will be deployed in single string systems in a phased manner to suit increasing Client loads.

11 The UPSs will be configured in double online conversion (DOC) mode and will be linked to each other via communications cabling to ensure good synchronisation is achieved.

12 This UPS arrangement will allow the ability to commission or decommission modules without service interruption.

13 UPSs will be configured with an adjustable parameter to permit / inhibit battery charging whilst supported by generator power.

14 The number of IT UPSs provided during this phase of works shall match the number of Power Modules.

15 Where UPS systems are used in parallel, effort shall be made to keep the input and output circuit impedance as similar as possible for equal current and fault sharing when using the internal bypass function. Consideration for the unequal division of fault current will be given for the selectivity study, where impedance between the UPS differs.

10.4.5 Landlord's UPS

01 In addition to the above-mentioned UPS systems, the landlord/life safety UPS systems shall back-up other specific areas such as:

1. Telco Rooms (MMR);
2. SERs;
3. Security rooms / security equipment;
4. Operations Room;
5. Client specific locations;

6. All controls and monitoring systems.

10.4.6 UPS Status Indication

01 Status and load monitoring information shall be provided by all UPS systems to the BMS. The Contractor shall be responsible for the supply and installation of all cabling and containment to suit. See supporting design documentation for BMS points lists.

02 Both landlord UPS systems shall be provided during this phase of works.

10.4.7 UPS Batteries

01 Each UPS system shall be provided with dedicated 10-year batteries configured in multiple strings.

02 Cost options shall be provided within the tender return for both VRLA and lithium-ion.

03 Batteries shall be supplied from the same manufacturer and the batch serial numbers shall be retained as part of the O&M and test script procedure.

04 Each battery string shall be provided with a D.C. battery fuse isolator.

05 Batteries shall be mounted on earthed open battery frames within cooled battery rooms located directly adjacent to the UPS rooms on the ground floor mezzanine level.

06 Batteries shall be monitored per string.

07 Individual battery monitoring shall not be provided.

08 Batteries shall not be stacked on stands where the top battery is positioned greater than 1800 mm AFFL. The contractor shall provide an access and method statement describing the installation of the battery to the battery stand and where required shall allow such access to allow the inclusion of lifting equipment where required to install the top tier of batteries.

09 All battery stands shall be referenced to their associated UPS system clearly on both the stand and the isolator.

10.4.8 Final Circuit Distribution Boards

01 The Contractor shall design the final distribution boards in compliance with CEI 64-8 (Italian Electrical Code), CEI 17-13 (Low Voltage Switchgear and Controlgear Assemblies), and IEC 61439 (Low Voltage Switchgear and Controlgear Assemblies).

02 The design shall ensure that all distribution boards are suitably rated to handle the electrical load of the building's operational and critical systems, while adhering to Milan's local electrical safety regulations and Fire department's fire safety codes.

03 The Contractor shall ensure that the final distribution boards are located in accessible, safe, and secure areas, with proper clearance for maintenance, operation, and emergency access. The location of the boards must comply with the Milan Municipal Fire Safety Code, ensuring they are placed away from high-risk areas and easily reachable in case of emergency.

04 All distribution boards shall be clearly labelled and designed to allow for safe isolation and fault detection.

05 The Contractor shall provide a series of Type B final circuit MCB distribution boards to supply the outgoing final circuits to general lighting and power, critical power and emergency lighting.

06 It will be the Contractor's responsibility to design detail the final sub-circuit wiring, and selection of distribution boards to ensure loads are balanced across the phases.

07 Type and rating of MCB/RCBO shall be selected to suit the circuit served. The Contractor shall seek approval from the engineer for all circuit protective device selections.

08 The Contractor shall provide metering to meet the criteria set out within the relevant standards. This will generally be achieved through split metering of power and lighting sections, with final sub-circuit metering provided where relevant.

09 The new distribution boards shall come complete with cable spreader boxes, where required.

10 Unused ways shall be fitted with blanking plates to allow future fit out designs.

11 Each distribution board shall be lockable and have installed a typed, approved distribution board schedule.

12 MCB rated fault clearing capacities shall exceed the prospective fault current at the point in the network it is installed.

13 All status of MCBs is to be reported on the BMS as detailed in other section of the BMS.

14 Each distribution board shall be labelled clearly with its reference and its origin of supply.

15 All distribution boards are to be provided with power meters and voltage presence indication lamps.

16 The distribution board meters will measure the following as a minimum: voltage, kWh, kVARh, kVAh delivered and received and MODBUS connection.

17 SPDs are to be provided in distribution boards in line with the requirements of EN 62305 as detailed on other sections of this specification.

18 Final circuit distribution boards are to be 25kA, with the final rating to be confirmed with the generator prior to ordering.

19 Unless detailed elsewhere no distribution board located in common areas shall be less than 1100 mm AFFL to bottom of panel.

20 Where any boards are installed externally they are to be provided with suitably rated enclosures and roofs to ensure safe working and lifetime of the boards.

10.4.9 Cabling, Cable Management and Support Systems

01 The Contractor shall provide and install all cabling, cable management and support systems, in compliance with the supporting design documentation.

02 Cable selection shall generally be as follows:

1. Final Circuits – Single/Multicore, low smoke halogen-free
2. Main and Sub Main – Single or Multicore, Copper or Aluminium, hard grade ethylene propylene (HEPR) rubber, low smoke halogen-free
3. External Cables – As main and sub-main cables.
4. Life Safety Final Circuits – Multicore, fire resistant to local standards.
5. Life Safety Sub Main Cables – Multicore, fire resistant to IEC 60331-1 and local standards.

03 All life safety equipment shall be provided with fire-rated cables. Life Safety Equipment shall include but not be limited to the following:

1. Emergency Lighting
2. Fire Detection and Alarm
3. Other life safety system

04 All fire-rated cables shall be sourced from manufacturers approved by local Civil Defence.

05 Where cables run in underground ducts, the Contractor shall provide cable supports as necessary.

06 Cable chambers shall be sited along the cable route in such a manner that the lowest pulling tension of the cables shall not be exceeded.

07 Where cables run in underground ducts, the ducts shall be sealed to prevent ingress of moisture, insects and vermin.

08 Cable and duct entries to buildings shall also be sealed to prevent the ingress of moisture, insects and vermin.

09 Generally, all electrical distribution is at high level, with the incoming utility MV system entering the power modules from low level.

10 Services from the individual critical power modules to the building shall be kept physically separate, for example services that are supplying the IT busbars are not to be routed on the same cable containment.

11 Where services pass through fire-resistant building fabric, fire stopping shall be provided that exceed the fire-resistant properties of the fabric or enclosure the service passes through.

12 Similarly, all services passing to the outside, for example those through the roof to the gantry, are to be appropriately waterproofed.

13 All externally routed containment is to be provided with covers to protect the cables from direct sunlight.

14 The Contractor is responsible for coordinating the final installation of containment runs to floorboxes within the screed floor, ensuring proper alignment, and minimising interference with other services.

15 The Contractor shall coordinate the provision of access hatches or openings in the gantries, designed to provide clear and unobstructed access to any containment systems located below. The size and location of these access points must be carefully planned to facilitate future maintenance and upgrades.

16 The Contractor must account for the provision and installation of any secondary containment systems (such as power, fire alarm, ELV, or other low voltage systems) that are necessary to support owner-provided equipment, including but not limited to power modules, generators, and other critical infrastructure. This includes ensuring sufficient space, appropriate routing, and compliance with relevant standards.

17 The Contractor shall ensure that all containment systems (primary and secondary) are designed and installed to meet the required load-bearing capacities, fire ratings, and environmental protection standards, in accordance with the latest regulations and best practices for data centre environments.

18 All containment routes and systems must be installed with proper support and bracketing to prevent movement or sagging over time, ensuring long-term reliability and ease of maintenance.

19 The Contractor is responsible for providing detailed coordination drawings that clearly show the routing and positioning of all containment, including any required modifications to structural elements, floorboxes, gantries, or other building systems.

20 The Contractor must ensure that all containment systems allow for future expansion and easy integration of additional equipment, taking into account anticipated load requirements, space constraints, and growth projections for the data centre.

21 Any conflicts with other building systems (e.g. HVAC, plumbing, etc.) during the containment installation must be promptly identified and resolved by the Contractor in consultation with the project design team.

22 The Contractor is required to conduct a thorough inspection of all installed containment systems upon completion, ensuring that all work is in full compliance with the design specifications, safety regulations, and quality standards before final handover.

23 The Contractor shall coordinate with other contractors and stakeholders to ensure that all required containment systems are installed in a timely manner and in accordance with the overall project schedule.

24 The Contractor must provide all necessary documentation, including as-built drawings, test reports, and certification of compliance for the containment systems, as part of the final handover package.

25 Where fire life safety services are in shared corridors with other services, these shall be provided at the highest level to prevent damage during a fire scenario.

26 The contractor shall ensure and shall demonstrate within his technical submissions and proposed working drawing both the physical access (with dimensions shown) and routing of services and that allowance has been made for the later installation of additional services. The building design is a concurrently maintainable design and the contractor shall ensure that later phases, together with the specific fitout of individual halls, can be achieved without the isolation of live commissioned systems.

27 As otherwise noted, there is a requirement for the Contractor to carry out the installation such that works for the initial phases do not inhibit the future installations.

28 Where possible inverted cable containment shall be avoided, unless prior permission from the engineer has been granted.

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10.4.10 Busbar Trunking Systems

01 The Contractor shall provide and install all busbar systems applicable to this phase of works, in compliance with the supporting design documentation.

02 Unless otherwise stated in the schedules, all busbars shall be 5 pole copper busbars.

03 Where busbar trunking passes through fire barriers, provide tested busbar fire rated sections to maintain the fire integrity of the barrier – these shall be in compliance with local Milan fire safety regulations.

04 The busbar trunking systems shall have a minimum fault withstand for 1s matching the associated switchboard they originate from. Busbars shall be selected for both the current carrying capacity requirements and expected fault level.

05 Busbars shall be rated in accordance with the environment they are installed. Where busbars pass through warm areas, manufacturer's recommended derating factor, based on empirical testing at that temperature shall be applied.

06 Where busbars transition between spaces that include expansion joints in the structure or move from different fixing systems, the contractor shall review the potential movement and if required shall install expansion pieces, either in bar or cable connections via end boxes.

07 Busbar shall be equipped with windows to allow for IR scanning of all connections.

08 Busbars shall be clearly referenced and labelled throughout their length.

09 Busbars shall be provided by the same manufacturer for each system of distribution for the entire length including termination sections.

10 Data hall server row busbars shall be rated for 1000A, with end feed unit equipped with power meter for measuring voltage, current, kW and kWh. For further details on the datahall busbar configuration, refer to the LV schematics.

11 Busbar plug-in tap offs are to be provided at each cabinet location as indicated in the project documentation. Final tap-off unit ratings to be agreed with the Client and Tenant prior to procurement and installation.

10.5 On-Site Generation

10.5.1 General

01 The entire building load shall be generator supported by the provision of a dedicated backup standby LV generators. Refer to generator specification for details and standards for the generators.

02 The Contractor shall ensure that the generator is selected to deliver the 100% standby rating.

03 The Contractor shall make allowance for providing a bund complete with a solenoid valve to contain oil in the event of an oil leak, but allow water to pass when raining. The collected oil shall be pumped to the glycol retention system.

04 The generator emissions, engine capacities, grouping and flue/chimney arrangements are fixed under the planning requirements of the project.

05 Emissions from generators shall be optimised and minimised in accordance with the planning requirements for the project. Refer to L22 planning documents for further details.

06 Concurrent maintainability is achieved through N+1 generators in a 6+1 block redundant arrangement for the Primary Critical systems and 4 from 5 distributed redundant arrangement for the Primary Mechanical Systems.

07 Refer to the schedules for generator capacities.

08 All sets shall be compliant with performance class G3 as defined by ISO 8528 Part 5.

09 Generators shall be provided with dual redundant batteries and chargers, powering dual redundant starter motors, sized in accordance with the accompanying documents with a 10 year design life.

10 Generators shall be provided by a single manufacturer for each data hall, meaning different suppliers can be used across the site. The manufacturer shall offer a turnkey solution including the generator container, control, fuel delivery and flues/chimney.

11 The generator emission flue outlets shall rise one meter above the height of the power modules.

12 The contractor shall be responsible for providing a self-supporting steel chimney stack, for housing the generator flues as required. It is envisaged that the generator vendor will provide the chimneys/flues, but this will be dependent on the contractor’s procurement method.

13 Pipework/connections between fill point cabinet, underground fuel tank and generator’s container are Vendor's scope of work.

14 Hardwired connections between BMS panel and different components of power generation plant are general contractor's scope of work, including fuel system, Urea system and generator container.

15 Power Module and Generator to be purchased by the owner complete with pre-wired internal connections. General Contractor to receive, hoist, place and install owner purchased equipment and provide all external connections. General Contractor to coordinate all works with other trades on site.

16 The Contractor shall be responsible for the safe installation and integration of the generators into the building's electrical infrastructure. This includes ensuring that the generators are installed in compliance with CEI 64-8 (Italian Electrical Code), CEI 11-27 (safety of electrical installations), and relevant local safety regulations, including Milan's fire safety codes and Fire department requirements. The installation shall be coordinated with all associated systems such as fuel supply, exhaust ventilation, and noise reduction measures.

17 The Contractor is responsible for ensuring that the generator installation includes the required ventilation, exhaust systems, and cooling mechanisms to operate efficiently and within environmental standards. The system must include safeguards to prevent the accumulation of exhaust fumes in the generator room and must comply with the relevant Milan air quality regulations. In addition, the Contractor must ensure the installation accounts for emission control systems as required by Italian environmental laws.

18 Container's tie-in points/openings are indicative only, final tie-in points shall be coordinated with the vendor.

19 Vendor shall extend exhaust flues 1m above electrical modules, if PV panels are installed above electrical modules, flues shall be extended further and terminated at 1m above the panel.

10.5.2 Generator Containers

01 The generator sets shall be housed within acoustically insulated weatherproof containers located externally.

02 Each engine shall also be provided with a dedicated attenuated exhaust gas flue system.

03 Each exhaust attenuation system is to terminate above the height of the power module as detailed in the drawings.

04 Generator containers shall be removable to aid in plant replacement. This is deemed a necessity due to the spatially restricted nature of the site.

05 Each generator set shall include noise control treatments for the air inlet, air discharge and engine exhaust. The contractor is to refer to planning documentation for details of acoustic treatment that is to be provided.

06 Each generator container shall be designed to allow for the future installation of a SCR exhaust treatment system at a later date. This design will factor in the additional weight and maintenance space that is required to access and install the SCR exhaust treatment system.

07 For each generator container refer to the generator specifications to determine all requirements.

10.5.3 Bulk Fuel Storage

01 Generator fuel storage shall comprise of a single bulk tank per generator. The bulk tank shall provide 48 hours of autonomy whilst operating under full load.

02 Bulk fuel storage tanks shall be located beneath the generator i.e belly tank.

03 The cost of the initial fuel fill and the fuel used for testing and commissioning shall be included by the contractor.

04 Any significant fuel spills shall require extraction to mobile tanker and treatment by a third party.

05 The Contactor is to refer to the generator OFCI responsibility matrix for details on installation and coordination works that are required as part of the bulk fuel system installation.

06 The general contractor is responsible for sign off all on the bulk fuel system with local authorities and is responsible for ensuring the correct separation distances and maintained from the bulk fuel tanks.

10.6 Earthing

10.6.1 Main Earthing

01 The Contractor shall design the earthing system for the data center in compliance with the CEI 64-8 (Italian Electrical Code) and IEC 60364 standards, as well as the relevant requirements of Italian Legislative Decree 81/08 (Occupational Safety and Health) and Milan Fire Department regulations. The earthing system must ensure safe and reliable operation of the electrical system, protecting both equipment and personnel from electric shock hazards, as well as providing proper protection for sensitive IT equipment.

02 The Contractor is to appoint a specialist earthing contractor to provide a complete MV and LV earthing installation to achieve the following:

1. Minimise potential difference between adjacent exposed conductive parts and extraneous conductive parts that may cause potential danger to persons or livestock;
2. Transfer of electrical current to earth, to protect personnel, buildings, structure, plant and equipment in the case of an electrical fault within the supply system and from interference from electromagnetic fields and electrostatic forces;
3. Compliance EN 50522, EN 50310, EN 62305 and all other relevant Italian standards;
4. Telecommunications earthing in accordance with ANSI TIA-607, BICSI TDMM, IEEE 1100, IEEE 81, ISO/IEC 30129:10 and NFPA 70 and EN 50310.

03 The Contractor shall ensure that all electrical equipment, including distribution boards, transformers, servers, and non-IT equipment, is adequately earthed. The design must include separate earthing for power and communication systems, ensuring no risk of interference or damage to sensitive building equipment. All earth conductors shall be sized appropriately to handle fault currents in line with CEI 64-8 and local safety regulations.

04 The earthing network/reference shall be derived from a new Building Main Earth Terminal (BMET), via a series of new earth electrodes interconnected via a tape ring distributed around the building.

05 From the BMET, a series of copper tapes shall be distributed around the building, with bonding conductors then provided to the earth bars to connect onto the copper tapes.

06 The Contractor shall provide a dedicated earth Building Main Earth Terminal (BMET) consisting of earth electrodes and a buried earthing mesh, with copper tapes providing the connection through corridors from the BMET to the earth bars.

07 The BMET and building distribution earth tape shall be as such, to ensure that there is an adequate earth path to all electrical systems after accounting for one break in the earthing distribution network at any point in the system.

08 The earthing system shall be designed with adequate redundancy to ensure that a failure in any single component does not compromise the safety of the facility. The Contractor shall ensure that multiple earthing points are provided, including connection to the site earth grid, and that all connections are inspected and tested to guarantee their integrity.

09 The earthing system shall be designed to maintain continuity in the event of electrical faults, in compliance with CEI 64-8 and EN 62305 (Protection against Lightning).

10 The complete earthing system shall have an overall resistance that limits the touch and step potential to within levels acceptable by EN 50522. This condition shall be met, accounting for the removal of any one earth electrode. The Contractor will be responsible for undertaking touch and step voltage limit calculations, and earth potential rise (EPR), which shall be used to guide the design. The Contractor shall be responsible for providing all earthing systems as required to stay within permitted limits, this could include extending the earthing system to the sitewide fence.

11 The earthing schematics show the indicative design intent; the contractor shall be responsible for locating, sizing and determining the quantity of earth electrodes to meet the design criteria.

12 The contractor shall carry out soil resistivity tests and use the values to verify the size of earth system, characteristics and quantity of the earthing conductors and electrodes required to achieve the required resistivity.

10.6.2 Circuit Protective Conductors

01 The contractor shall provide circuit protective conductors (CPC) of sufficient size and rating to all electrical circuits as required to achieve adequate disconnection times and not exceed adiabatic limits.

10.6.3 Bonding

01 The Contractor shall provide a common bonded functional earthing system, comprising of a network of earth bars which shall be bonded with appropriately sized conductors to the relevant exposed and extraneous conductive parts through the building.

02 In addition to the earth bars for equipotential and supplementary bonding, the Contractor shall provide a series of telecommunications earth bars and associated telecommunications bonding conductors (TBCs) and a telecommunications bonding backbone (TBB), to facilitate the future tenant Data Hall supplementary bonding installation.

10.7 Lightning Protection

01 The Contractor shall design and install a lightning protection system in accordance with CEI 81-10 (Italian Standard for Protection Against Lightning), IEC 62305 (Protection of Structures Against Lightning), and the relevant provisions of Italian Legislative Decree 81/08 (Occupational Safety and Health).

02 The system must be designed to protect the facility from the direct and indirect effects of lightning strikes, ensuring the safety of both personnel and equipment.

03 The Contractor shall appoint an approved Specialist Lightning Protection Contractor who shall provide the lightning protection system in accordance with EN 62305.

04 For the quality and workmanship requirements of lightning protection systems, refer to Black & White Project Documents.

05 Lightning protection system shall provide complete coverage of the building to the appropriate level of protection (LPL) as identified from the lightning risk assessment. The minimum expected level of protection is a Class I lightning protection system, but this shall be confirmed by the Specialist Lightning Protection Contractor.

06 The required system classification shall be determined by the Contractor's lightning protection risk assessment.

07 The lightning protection system must protect all critical infrastructure of the building, including but not limited to:

1. Building structure: External surfaces, roof, and any high points.
2. Electrical distribution systems: Incoming power lines, transformers, distribution boards, and sensitive IT equipment.
3. Telecommunications and data lines: All external communication lines entering the building should be properly protected. The Contractor is responsible for ensuring that all critical components are adequately protected from lightning-induced surges and faults.

08 The lighting protection and earthing series of drawings provide an indication of the design intent of the lightning protection systems, the Lightning Protection Specialist shall be fully responsible for the design of the lightning protection system, including conducting a risk assessment to determine the level of protection required.

09 The Specialist shall coordinate with the Contractor to ensure all necessary allowances are made for integrating the lightning protection system with respect to the building construction.

10 The works shall include the provision of new roof mounted earth termination networks, connected to and utilising the down conductors, before terminating into earth via the new soil mesh networks and buried perimeter ring conductor.

11 Tapes shall generally be 30 mm x 3.5 mm stainless steel tapes in accordance with AISI/ASTM 316 Ti, with allowance made for coloured PVC sheath. The colour shall be determined later in conjunction with the architect. The contractor shall allow for any standard colour range colour.

12 As per the requirements of EN 62305, all plant, extraneous and exposed conductive parts, structure at roof level shall be bonded to the lightning protection system.

13 The Contractor shall ensure that the lightning protection system is integrated with the existing earthing system in accordance with CEI 64-8 and IEC 62305. The system shall include a low-resistance path to earth for the dissipation of lightning energy.

14 All external conductors, rods, and bonding components shall be correctly sized and positioned to provide effective protection, with appropriate redundancy to ensure system reliability during fault conditions.

15 The Contractor shall integrate the lightning and surge protection systems of ancillary buildings with the main building's protection systems to provide coordinated protection across the entire site, ensuring compliance with CEI 81-10 and IEC 62305.

16 For critical plant (for example chillers) and equipment not suitable for direct lightning strike (for example satellite dishes) supply an enhanced air termination network with air termination finials to provide protection against direct lightning strike.

17 The current design employs an isolated lightning protection system. High-voltage resistant insulated (HVI) cables shall be used as part of the isolated lightning protection system, with separation distances in accordance with EN 62305.

18 The Contractor shall verify the design with the appointed Specialist.

19 Surge protection devices to be provided to in line with EN 62305 on all primary switchgear supplying critical IT equipment and to electrical switchgear with a direct connection to the external environment, including but not limited to the below:

1. Switchgear housed externally.

2. Switchgear supplied busbar or cabling from external sources.

20 The earth termination network is shown indicatively, the contractor shall be responsible for submitting their proposal and costs at tender stage for compliance with EN 62305, based on either a closed or open ring earth termination network, with either a mesh or perimeter termination system.

21 As per the requirements of EN 62305-4, embedded bonding conductors shall be provided within the slabs at each floor level, connection points shall be provided at each tape joint / overlap to allow bonding to the sitewide earthing system.

10.8 Small and Fixed Power

10.8.1 Requirement

01 The Contractor shall design the small power distribution system to meet the operational requirements of the facility, ensuring that all electrical circuits are capable of supporting the power needs of equipment such as servers, workstations, IT racks, and other operational infrastructure. The design must comply with the CEI 64-8 (Italian Electrical Code), CEI 11-27 (Safety of Electrical Installations), and all relevant Milan municipal regulations. Proper circuit protection, load distribution, and fault tolerance must be incorporated into the design.

02 Provide and set to work a network of small and fixed power circuits including their associated switchgear, outlets, associated final sub circuit cabling and containment systems to ensure systems as specified herein are electrically supported.

03 For the quality and workmanship requirements for small and fixed power, refer to Black & White Project Documents.

04 The contractor shall verify the cable calculations for all submains cables and provide final circuit calculations upon selection of final equipment, using a leading cable calculation software, such as Amtech by Trimble (or agreed equivalent).

05 All of the required power supplies, especially those for specialist systems, may not be outlined on the drawings at this Stage; there will however be an explicit responsibility for the contractor to coordinate with their specialist sub-contractors, and make all necessary small power allowances at tender stage (power supplies, means of isolation etc.). Refer to CDP section for works that are required.

06 Contractor to make allowances for future end user small power requirements (based on agreed final scope from Stack/Customer).

10.8.2 General Power Outlets

01 Provide a series of 16 A Type F socket outlets and fused connection units to ensure the building operational requirements can be met and the building services systems are electrically supported.

02 Socket outlets in office, breakout and facilities areas shall come complete with dual 4A USB charging outlets.

03 Cleaner’s sockets shall be provided throughout the facility, spaced to ensure all areas are able to be covered by cleaners, based upon a 15 m cleaning equipment lead radius. At least one cleaner’s socket shall be provided per room.

04 Dedicated radial final sub-circuits, protected by RCBOs, shall be provide for hand dryers and sensor taps throughout toilet areas.

05 Fused connection units to life safety and security equipment shall be of unswitched type.

06 Final socket outlets throughout shall be manufactured by MK electrical or agreed equivalent in line with architect and client requirements.

07 All power cabling associated with the fire alarm installation shall terminate within locally mounted non switched fused connection units.

08 Final connections to life safety equipment shall utilise FTG18OM16 PH120 cables in line with EN 54 & CEN/TS 54.

09 Lift submain cables shall terminate within switch disconnectors with a rating and type as agreed with the lift manufacturer.

10 Final sub-circuits for general small power shall be wired from the power section of the general lighting and power split metered distribution boards.

11 General power circuits shall be wired in single core/multicore, hard grade ethylene propylene (HEPR) rubber, low smoke halogen-free type cables, on LV tray with galvanised steel conduit used for final connection. 4 mm^2 shall be the typical cross-sectional area for small power services, with 2.5 mm^2 being the acceptable minimum.

10.8.3 Critical Power

01 Where denoted on the drawings, below, and elsewhere within the project documents, provide power from the critical UPS backed distribution boards to ensure that the services remain operational during a power failure.

02 The Contractor shall ensure that the small power system incorporates redundancy for critical circuits, in compliance with Italian Legislative Decree 81/08 (Occupational Safety and Health) and CEI 64-8.

03 Unless stated otherwise, critical power shall be derived from two diverse critical distribution boards, generally via two fused connection units.

04 Provide critical UPS backed power to, but not limited to, the following:

1. Controllers to critical plant (both integral and external controllers);
2. PMS/BMS/EMS switches, servers, controllers, outstations, network devices and all associated ancillary equipment;
3. Meters, protection and controls to LV and MV switchgear;
4. All security systems (access control, CCTV and intruder alarm). Final details and quantities of the
5. Telecommunications equipment.

05 The Contractor shall allow for dual power supplies to the relevant BMS panels and IT racks as shown on the project drawings.

06 The internal low-voltage power auxiliary installation within the generator rooms shall be by the generator provider. An isolator shall be provided for their installation downstream.

07 Critical power services shall be wired generally in hard grade ethylene propylene (HEPR) rubber, low smoke halogen-free type cabling.

10.8.4 Mechanical and Public Health Power

01 The Contractor shall ensure that the small power distribution system is fully integrated with the mechanical and public health plant systems. This includes ensuring appropriate electrical connections for HVAC systems, fire protection systems, water pumps, and other critical services.

02 The electrical design must be coordinated with the mechanical and public health teams to ensure operational reliability, especially for cooling and emergency systems critical to the data centre's operation.

03 The Contractor is responsible for conducting detailed load calculations to determine the power requirements for each mechanical and public health plant component.

04 The design shall ensure that the small power distribution system is capable of handling the load of these components, with proper circuit protection and coordination, in compliance with CEI 64-8 and the relevant local Code. Adequate consideration must be given to redundancy for critical systems where required.

05 Provide a series of power supplies and final equipment isolators, to electrically support the Mechanical and Public Health plant/systems located internally and externally.

06 Power supplies shall be provided for all plant and associated ancillaries, for example valves, controls and dampers.

10.8.5 Fan Wall Units(FWU)

01 Data hall fan wall units shall be dual supplied: the primary supply coming directly from a busbar served from the MUPS output board in the PCS power module and the secondary supply coming from a busbar served from the MUPS output board in the RCS (reserve block) power module.

02 The drawings show direct connections for clarity purpose to the FWUs, but it is generally expected that the supplies shall terminate directly into an ATS (depending on final equipment selection).

03 The supplies to the FWUs within each Data Hall, shall be split across the power modules, so that there are generally equal number of FWUs in each Data Hall supplied from each power module.

10.8.6 Cooling Distribution Units (CDUs)

01 Data hall CDUs shall be dual supplied: the primary supply coming directly from a busbar served from the MUPS output board in the PCS power module and the secondary supply coming from a busbar served from the MUPS output board in the RCS (reserve block) power module.

02 The drawings show direct connections for clarity purpose to the CDUs, but it is generally expected that the supplies shall terminate directly into an ATS (depending on final equipment selection).

03 The supplies to the CDUs within each Data Hall, shall be split across the power modules, so that there are generally equal number of CDUs in each Data Hall supplied from each power module.

10.8.7 Chillers and Primary Pumps

01 Chillers shall be supplied from dedicated sub-main circuits from the Primary Mechanical Power modules, in a 5 from 4 distributed redundant arrangement. For details, please refer to the LV schematics.

02 Where the supplies transition from the gantry to roof above, fixed cleats onto heavy duty Unistrut is acceptable, pending that the short circuit restraints are met.

03 Special consideration is required with the Chiller manufacturer to ensure that sufficient space is allowed for cable glanding, cable bending radii and the termination size.

10.8.8 Water Saving Solenoid Valves

01 Provide a switched interface in each toilet to supply and switch the water saver solenoid valve based upon the activation of the local occupancy sensor.

02 The power supply for the valves shall be via a local switched fused connection unit but shall be controlled by activation of an occupancy sensor.

10.8.9 Trace Heating

01 Provide a series of dedicated circuits to the required number of trace heating panels, for the sole use of the trace heating of the pipework. Final circuits to trace heating services shall be RCBO protected in accordance with local code.

10.9 Lighting

10.9.1 General

01 A full system of lighting, incorporating general task and feature lighting and associated controls, shall be provided throughout to ensure that internal and external areas are adequately illuminated to meet the operational requirements of the building. The lighting shall also comply with local regulations in Milan and the standards of Vigili del Fuoco (Milan Fire Department) regarding safety, accessibility, and visibility.

02 For the quality and workmanship requirements for interior lighting systems, refer to Black & White Project Documents.

03 Reference shall be made to the luminaire schedule which specifies the luminaires on an agreed equivalent basis.

04 Luminaires shall be suitable for continuous operation in the environment they are installed, in particular luminaires within the MEP Gallery and Data Hall hot aisles shall be 40°C rated to be able to withstand the environmental conditions of the hot aisle containment and return air plenum.

05 A manufacturer statement of compliance outlining the lamp lumen maintenance factor (LLMF) at =a continuous 40°C is required for any luminaires proposed. This is to be a minimum of L70 at 50,000 hours.

06 Lighting in Data Halls shall be suspended and shall be configured to allow IT equipment to be deployed at any location whilst still maintaining good lux levels within the aisles and on the vertical faces of racks.

07 Lighting in plant areas shall be suspended and shall be generally supplied by heavy duty galvanised steel conduit and rock rose type connections.

08 Where lights are to be suspended in plantrooms and corridors, these shall be suspended with rigid galvanised steel drop rods to prevent movement due to the high volume of airflow.

09 Stairwell luminaires shall be supplied by a network of galvanised steel conduit running through the centre and around the stair core.

10 Lighting shall be provided immediately outside each final exit either directly above the doorway or adjacent. The minimum height above ground shall be 2100 mm.

11 The Contractor shall prepare and execute a detailed testing and commissioning plan to ensure the correct operation of the general lighting system. This shall include testing the functionality, illuminance levels, and energy performance of all lighting fixtures. The Contractor must provide certification that the system complies with CEI 64-8, EN 12464-1, and Milan's local fire and safety regulations.

10.9.2 Design

01 The Contractor shall ensure that the general lighting design for the data centre is in compliance with the CEI 64-8 (Italian Electrical Code), EN 12464-1 (Lighting of work places), and the relevant Italian Legislative Decree 81/08 (Occupational Safety and Health) for all workspaces.

02 Lighting levels throughout shall achieve, but not exceed substantially illuminance levels outlined in UNI EN 12464 and the end user's requirements.

03 Illuminance levels for lighting in all external areas within the construction zone shall meet the requirements set out in UNI EN 12464-2, and the illuminance levels in line with the end user's requirements.

04 Generally, lights shall derive power from lighting radial circuits supplied on LV cable tray. The cable cross sectional area shall generally be 2.5 mm^2, with a minimum of 1.5 mm^2.

05 The Contractor is responsible for integrating the general lighting system with the overall electrical infrastructure, ensuring that all lighting circuits are appropriately distributed across the facility. The design must account for the specific requirements of each space, including the data halls, offices, corridors, and common areas, ensuring uniform light levels in line with the operational and safety requirements.

06 Lighting shall be supplied from a separately metered lighting section of general lighting and power distribution boards or from dedicated metered lighting distribution boards, in accordance with the local energy regulations.

07 The initial circuit luminous efficacy for fixed lighting installations is in excess of 60 lumens per circuit-Watt and achieves an installed load for lighting not greater than W/m^2.

10.9.3 Lighting Control

01 Lighting controls shall be configured to ensure lights are controlled with respect to the operational requirements of the building and are on for the minimum time in order to reduce energy costs.

02 Lighting control within Data Hall shall be via microwave sensors, due to the increased temperature from the hot aisle.

03 Plant areas shall be controlled by DALI occupancy detectors and shall be commissioned to ensure suitable absence time duration before the lighting is switched to minimum levels.

04 Office and breakout spaces shall be provided with an intelligent DALI addressable lighting control system, to provide PIR occupancy detection and daylighting controls where daylight is present.

05 The indoor lighting control system is to be commissioned so that it will support video surveillance. The lighting must not be lower than 2 lux at any time in the field of view of the camera.

06 On completion of the lighting control system works, the Contractor shall allow for attendance from the lighting control specialist for commissioning, and a further two days for system demonstration and training.

07 External lighting shall be controlled via photocell and time clock arrangements, connected to a contactor. New fittings shall be selected for reduction of night time light pollution to comply with the planning requirements.

08 The security operations centre shall have a separate facility that will allow them to switch on all external luminaires on intruder detection by operation of a switch. This security override switch(s) shall be multi gang to enable simultaneous operation of the external luminaire circuits and also to enable operation.

09 The Contractor to ensure fused connection units are provided to the area controllers and lighting control modules (LCMs) for the lighting control system.

10.10 Emergency Lighting

10.10.1 Requirements

01 The Contractor shall design and implement an emergency lighting system in accordance with CEI 64-8, EN 1838, and the requirements of Italian Legislative Decree 81/08.

02 The Contractor shall provide emergency lighting in all areas in line with to assist in the evacuation of personnel, for anti-panic and to allow critical systems to be operated under mains power failure conditions.

03 For the quality and workmanship requirements for emergency lighting systems, refer to Black & White Project Documents.

04 The emergency lighting to all areas except external fire escape routes and data hall hot-aisles shall be served by integral batteries in the luminaires. For external fire escape routes and data hall hot-aisles emergency lighting via central battery system shall be utilised.

05 The Contractor shall ensure that the emergency lighting for the data hall hot aisles and external fire escape routes is backed by a central battery system, designed to provide reliable, continuous lighting in the event of a power failure. The design must meet the minimum required duration of illumination as outlined in CEI 64-8 and EN 1838, ensuring that the central battery system is sized to support these specific areas for the required time.

06 During normal operation, the power supply to the emergency luminaires is obtained from the incoming mains power supply to the board, which additionally charges the batteries. During a power failure, the system goes into emergency mode and the power to the emergency luminaires is obtained from contained batteries.

07 The emergency lighting system batteries shall be designed to provide a minimum of 1hr autonomy for general areas and 2hr autonomy for office areas and fire escape routes in accordance with CEI 64-8 and EN 50171. The final sizing shall be confirmed by the Contractor during their detailed design, to account for the loadings of the final phase of the development.

08 The battery system shall be designed to allow the emergency lighting system to continue to function in the event of maintenance on the system.

09 The Contractor is responsible for coordinating the emergency lighting design with the overall power distribution system, ensuring that the central battery system is integrated seamlessly and that all critical areas are supported during emergencies. The system design must meet the standards for Milan Fire Department (Vigili del Fuoco), ensuring that emergency lighting is both functional and compliant with local fire safety regulations.

10 The emergency lighting shall generally be in accordance will all national and European standards. Refer to the emergency lighting standard specification for the complete list of standards.

11 The system shall use a combination of non-maintained luminaires. Where luminaires are suffixed with “/E”, this shall be taken to mean that these are for the emergency lighting system.

12 The system shall be as detailed in the luminaire schedule or agreed equivalent.

13 Maintained emergency exit signs shall also be provided as required at exit points and relevant changes in direction.

14 All final exits and routes from the building shall have emergency lighting. The Contractor shall ensure the emergency lighting used for escape of the building shall convey the occupants to a safe place designated outside of the building. To this extent the emergency lighting shall be provided outside final exits and where necessary externally to illuminate pathways. Refer to the fire strategy drawings for fire escape routes.

15 Although the emergency lighting design will, at a minimum, achieve the requirements set out within and other relevant standards, there will be an increase emergency lighting provision within Data Halls and plant rooms as follows:

1. Data Hall emergency lighting shall be increased to have a minimum of one emergency light per four normal luminaires.
2. Critical plant rooms shall be increased to have a minimum of one emergency light per three normal luminaires.

16 The Contractor shall provide a comprehensive testing and commissioning plan to verify the functionality and performance of the emergency lighting system, particularly for the data hall hot aisles and external fire escape routes. Test provision for the emergency luminaires is to be conducted via a dedicated emergency lighting panel which shall simulate the loss of supply to the normal luminaires thereby testing the emergency lights.

17 Testing must be carried out in accordance with CEI 64-8, EN 1838, and other relevant standards. The Contractor shall ensure the system is certified as compliant with local Milan fire and safety regulations and provide documentation for approval by Milan Fire Department.

10.10.2 Emergency lighting function

01 The system design shall incorporate sub-circuit monitoring for non-maintained luminaires and maintained switching devices for maintained luminaires where indicated. When a normal lighting circuit fails the dedicated emergency fittings shall be powered from the inverter supply.

02 For non-maintained luminaires:

1. Local controllers shall be connected to every circuit to monitor the local normal lighting distribution boards and switch on the non-maintained luminaries during a supply failure on the normal circuit;
2. There shall be no separate data cabling required between the local controllers, luminaries and panels. All necessary data transfer shall take place through the standard power supply cabling of the luminaires;
3. Continuous monitoring and control of the lighting distribution boards shall be made by dedicated sub-circuit monitoring. The sub-circuit monitoring devices shall ensure that the emergency lights are illuminated following the loss of power to the normal lights within that area;
4. Each circuit shall have its own local controller so that a possible failure of a single controller does not affect the other circuits;
5. The non-maintained luminaires within an area shall be lit during a local supply failure. However, the emergency supply panel shall not switch to battery use if its own mains supply is available;
6. The local controllers shall comply to EN 61347-2-11:2001 in conjunction with EN 61347-1:2001.

03 For the central battery backed luminaires:

1. The central battery system shall be connected to each emergency luminaire and emergency power load to ensure continuous operation during a power failure. The system shall be designed to automatically switch on emergency luminaires in the event of a failure of the normal supply circuit.;
2. There shall be no separate data cabling required between the local controllers, luminaries and panels. All necessary data transfer shall take place through the standard power supply cabling of the luminaires;

3. The central battery system shall include dedicated sub-circuit monitoring for each emergency lighting circuit, ensuring continuous monitoring of the battery status and the operation of the emergency lighting. The sub-circuit monitoring devices shall automatically verify that emergency lighting is activated in the event of a failure of the normal power supply to any part of the facility;

4. Each circuit shall have its own local controller so that a possible failure of a single controller does not affect the other circuits;

5. The central battery system shall only switch to battery power when the normal power supply is unavailable. If the normal supply to the emergency power panel is still available, the central battery system shall not engage its backup power. However, in the event of a mains failure, the emergency lighting shall automatically switch to battery backup to maintain illumination;

6. The central battery system and its components, including the local controllers, monitoring devices, and emergency luminaires, shall comply with the relevant standards, including EN 50171 (Central power supply systems for emergency lighting) and CEI 64-8. The system shall also meet all local safety and fire regulations as per Italian Legislative Decree 81/08 and Fire Department.

10.11 Life Safety

10.11.1 Requirements

01 The Contractor shall ensure that all life safety systems, including but not limited to fire alarm systems, emergency lighting, smoke extraction, and emergency power supplies, are supplied with power in accordance with Italian regulations, CEI standards, and the relevant European Union directives (e.g., EN 50172, EN 12094).

02 The design must ensure compliance with Italian Legislative Decree 81/08 on workplace safety, including provisions for emergency power in the event of a mains failure. The emergency power supply shall ensure that all life safety systems operate continuously for the required duration during a power failure, with adequate capacity and redundancy to meet local regulatory requirements.

03 The Contractor shall review and verify the power distribution to life safety systems during RIBA Stage 4, ensuring the final design is fully coordinated with the electrical, fire protection, and mechanical systems. The design must adhere to the local safety codes established by the Vigili del Fuoco (Italian Fire Brigade) and comply with all Milan-specific regulations for emergency and life safety systems.

04 The Contractor shall perform detailed load calculations for all life safety systems and ensure the power supplies meet operational demands with appropriate redundancy. This includes providing dual power feeds, automatic transfer switches (ATS), and ensuring compliance with CEI 64-8 for safety, resilience, and operational reliability under emergency conditions.

05 There are various critical systems which are deemed life-safety systems as part of the fire strategy, including but not limited to the below:

1. Smoke Extract: Supported by the and power system mains and generators via ATS;

2. Alarm systems: Supported integral batteries with 180 minutes autonomy or as per local code;

06 The Contractor shall make allowance for switchgear and generator capacity as required to facilitate the entire building's life safety services infrastructure.

07 Where life safety installations are to be supported by the power module generators, the following shall be provided:

1. All fire rating performance of the cabling and busbar infrastructure throughout the life-safety electrical supply (both the utility and generator supplies) shall match the autonomy required of the system served and shall generally be F180.

2. All life safety equipment and plant shall be functional within 15s of a mains outage.

10.12 Facilities for the Disabled

10.12.1 Requirement

01 The Contractor shall provide a series of systems to aid the less ambulant in safely accessing, using and evacuating the building as described below.

10.12.2 Disabled Refuge Alarm

01 The contractor shall provide Disabled Refuge call system, in accordance with the fire strategy report and all regulations and technical standards, forming part of a Disabled Refuge alarm system to facilitate two-way communications between the disabled refuge Type B outstations and the control panel located at ground level.

02 The main control unit shall be located behind within the FOC (final location to be agreed with the Approved Inspector) and shall be equipped within a stainless-steel recessed enclosure.

10.12.3 Disabled Persons Alarm

01 The Contractor shall provide a series of disabled persons alarms to all disabled WCs and shower facilities, to alert the onsite staff should a person become distressed whilst using the disabled WC.

02 The system shall comprise of an alarm pull cord switch located within each disabled WC and shower, located in reach of persons sitting at the pan, shower or both where combined facilities are constructed, means of system local reset switch also positioned within reach of the WC pan and local sounder.

03 The system shall be supplied from a central panel within the FOC, where alarms will also be generated.

10.12.4 Induction Loops

01 The Contractor shall provide induction loops, in accordance with EN 60118-4, within the following areas:

1. Main reception area and Vestibule;
2. External main entrance Tiger Trap;
3. Main Entrances.

Provide all associated notices and identification displaying the system location

11.0 FIRE DETECTION

11.1 Requirement

01 A complete fire detection, alarm and suppression system shall be provided throughout the building, which shall comply with the operational requirements outlined herein and the project documents, as well as all regulations and technical standards.

02 The fire detection and alarm system shall be a Class I classified system.

03 Addressable fire alarm control panel along with smoke, heat detectors, break glass/manual call point, sounders, strobes and shall be installed. The entire components are powered by primary power supply and secondary power supply through batteries.
Fire rated cables to be used for detection system and FP200 cables for emergency / Exit. Fire Detection and Alarm wiring will be 2-hour fire rated drawn. There will be 2 types of loop/circuits from each FACP.

1. Detector Loop - the fire alarm detector loop will follow Class A wiring. The detector loop will have the addressable devices such as detectors, interface modules and manual call point.

2. Notification Circuit - the sounder and flashers will be provided on this circuit.

04 The regulations (TAB) of the local fire department are to be noted and followed.

05 The fire protection system shall be in accordance with local Italy regulations and local fire department.

11.1.1 Main Equipment Room(s) location:

1. Main Fire Alarm Control Panel (MFACP) – 1 no. MFACP will be provided within the Data Center Emergency Command Center room while a repeater panel will be located at the Loading dock, SOC, Guard Booth .

2. The repeater panel is providing a full indication of events for MFACP and it will also offer fire system controls (such as silence, reset etc.) from the repeater panel.

3. Graphical user Interface Workstation - A Fire alarm system workstation for control/monitoring will be located in the FOC room.

11.2 Fire Detection and Alarm Systems

01 A complete fire detection system shall be designed and supplied to meet the requirements of the appropriate local authorities and fire strategy.

02 The complete fire detection and alarm systems for the building shall be fully open protocol. 'Managed' or 'closed' protocol systems will not be accepted.

03 The detection and alarm systems shall consist of multi loop analogue addressable fire alarm panels (FAPs) hardwired to field devices for detection, alarm and interface.

04 Where there are accessible voids, allowance shall be made for Xenon beacons and sounders to adequately alert an operative within the void that the building is being evacuated.

05 Fire detection to Data Halls, shall be on a 'double-knock' basis, whereby there are two detection system both above and below the ceiling. This will actuate the pre-action valves to charge the pipework.

06 The building shall be divided into detection zones and alarm zones based on area and fire compartmentation. The position and size of detection zones shall be developed during the detailed design stage with input from the Fire Officer. There shall also be alarm zones to provide alarms in certain areas of the building depending on the use of the area.

07 Within each zone, a range of detecting and alarm devices shall be employed to suit the application. These will include:

1. Optical Acoustic panels;

2. Manual call points;

3. Automatic optical and ionisation type smoke detectors;

4. Duct mounted detectors;
5. Linear Heat Detector ;
6. Aspirating smoke detection systems;
7. Remote indicators for detectors located within concealed spaces;
8. I/O and interface units.

08 The provision of detection points within all areas shall comply with the relevant local standards, but shall be increased within Data Halls to include the requirements of fire detection within telecommunication centres.

09 Fire detection shall be in accordance with the below standards as a minimum:

1. EN 54,
2. UNI 9795,
3. DIN 14675 Teil 1 und 2,
4. VdS 2095,
5. LAR,
6. Brandschutzkonzept / fire protection concept,

10 Each networked fire alarm panel (FAP) shall be capable of displaying a pneumonic text description indicating the zone reference, device reference and alarm location for any alarm within the demise.

11 This head end PC software shall also be capable of alerting for alarms, faults and logging all alarm and fault history as well as enabling system configuration and alarm / zone inhibits.

12 All fire related services shall be cabled using an enhances level fire rated cable. This will be Red fire resistant multicore cabling tested to EN 50200-Annex E or agreed equivalent. Enhanced cables are deemed necessary as combined sounder detector bases are used and the sounder circuits are required to operate during a fire incidence.

13 The double-sided wiring of all the loops and the installed devices uses fire system wiring of the type J-Y (ST)Y in accordance with VDE 0815, symmetrical with red outer sheath and the label Brandmeldekabel".

14 Fixings, bracketry and containment throughout shall be selected to exceed the fire integrity of the cables.

15 Fire alarm systems shall be provided with a battery suitable for 15-minutes of full operation following a power outage of 24 hours.

16 The fire detection and alarm system shall be supported by an infrastructure of power supply and electrical service containment throughout the building.

17 Within areas for future development not included within this phase, a temporary fire detection and alarm system shall be provided to allow property and life protection.

18 The Contractor shall ensure that the fire detection system is configured such that future phase fire detection and alarm panels can be added without disruption to the incumbent system. The system shall be expandable to allow for all future panels.

19 A fully functional temporary fire detection system shall be provided in all areas not within the initial scope of the building, this shall include all rooms.

11.2.1 Data Halls / MMRs

01 Data Halls shall be provided with a 'double-knock' fire detection and alarming system, with multi-criteria point detectors below the ceiling, with adjacent co-incident detectors providing the two 'knocks'. Co-incident detectors shall charge the Data Hall pipework via double-interlocked pre-action valves.

02 Below ceiling detectors shall be spaced with respect to the decreased operating radii of smoke detectors in high air velocity environments. The Contractor's internal Data Hall CFD shall be utilised to determine the maximum spacings between detectors.

03 The Contractor shall ensure that the selected smoke detectors are suitable for the high air velocity within the Data Halls. Manufacturer's confirmation and a testing certificate shall be required to demonstrate this.

04 The ceiling void is to be kept devoid of electrical services to limit the extent of fire suppression. As such, void detection shall be provided with a single knock aspirating detection system. The selected aspirating pipework shall be maintenance free, such that no future maintenance is required to the ceiling void detection system.

05 An early warning aspirating detection system shall be provided within the return air path of the CRAH units; this is to serve as an early warning only for business continuity rather than life safety. A reference air sample shall be taken from an associated data hall air handling unit, as to ensure nuisance operation does not occur.

11.2.2 Electrical Switch rooms

01 Electrical Switch rooms shall be provided with a double knock fire detection and alarm system via point detectors and aspirating Smoke detector. .

02 The fire detection shall charge the dry pipe via single-interlocked pre-action valves.

03 Plant rooms are deemed areas of high risk and shall be provided with manual call points.

11.2.3 HV Switch rooms / Generator MV switch rooms

01 High voltage switch rooms and the generator switchboard rooms shall be provided with Heat & Flame Detector.

02 Plant rooms are deemed areas of high risk and shall be provided with manual call points.

11.2.4 General areas

01 General ancillary areas, offices and corridors shall be provided with a single-knock fire detection and alarm system via point optical smoke detectors, or heat detectors where appropriate.

11.2.5 External areas

01 The Contractor shall ensure that xenon beacons and sounders are provided externally around the building perimeter, and throughout the roof area, to ensure that operatives are sufficiently warned to evacuate in the event of a fire scenario.

11.3 Fire Alarm Interfaces

01 Fire alarm interface units shall be provided for connection to such items as the mechanical control centres, smoke ventilation units, lifts, lighting control and access control, fire suppression system and lift system systems as necessary to fulfil the cause and effect requirements.

02 The lifts shall be connected to fire alarm system and shall ground on alarm or the lifts shall go to an alternative floor, say first floor, if the fire is on ground floor.

03 Fire alarm interfaces shall be provided to all access-controlled doors forming the emergency exit routes, to ensure that the doors release under fire conditions. The interfaces are to be coordinated with the security door lock mechanisms.

04 The fire alarm system shall be interfaced to the mechanical services plant to shut down the ventilation and smoke dampers where relevant.

05 Other trades will be connected to the fire alarm system using input / output modules as follows but not limited to:

1. Elevators (fire control system)
2. Manual call points (pullstations)
3. Smoke aspiration Systems
4. Input/Output Modules
5. Natural smoke exhaust systems /RWA Systems
6. Emergency lighting
7. Smoke extraction
8. Fire dampers and such
9. Gates
10. Burglary and Access-Control System
11. Authorities and organizations with security tasks-Systems (if necessary)
12. Fire overhead-doors / doors
13. Cooling Systems
14. HVAC systems
15. Fire suppression systems
16. Building automation

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11.4 Fire Systems Cause and Effect (C&E) Overview

01 The Contractor shall develop a fire alarm cause and effect matrix for approval by the employer, engineer, Building Control Representative/Local Authorities. Refer to the appendix for an outline overview of the design intent of the fire systems cause and effect.

02 The cause and effect shall be developed in line with the building fire strategy and shall be suitable with respect to maximising uptime of the critical systems in a safe manner.

03 All fire systems shall operate on a principle of coincidence detection (double knock).

04 The fire systems shall be connected to the local fire brigade via the ‘House’ system. The fire brigade shall only be called on production of an ‘evacuation’ alarm which in turn is only generated by the coincidence operation of two detecting devices, or one manual call point, within a single zone.

05 The building shall be simultaneous evacuation, following a 'one out, all out' strategy. As such, a Public Address/Voice Alarm (PAVA) system will not be provided, instead common building alarm sounders and xenon beacons shall be utilized for evacuation.

06 The extent of the period of investigation shall be determined in the fire alarm cause and effect and approved by Building Control/Local Authorities.

07 A signal to evacuate, once initiated, will be actuated on all network fire alarm panels allowing the facility to go into full evacuation.

08 Where early warning aspirating smoke detection system is provided within the return air plenum of the CRAC units for early warning only, this will not initiate evacuation, nor cause plant to shut down or the suppression system to operate.

09 For the preaction sprinkler systems, coincident fire signals shall pre-activate/flood the system, with frangible bulbs at heads required to be broken via high temperatures before water is released.

10 All critical cooling plant (chillers, pumps and CRAH units) shall remain operational during a fire scenario.

11 To prevent the spreading of fire and smoke into the data halls, any ventilation plant that transfers smoke through multiple fire compartments (data hall pressurization AHUs) is to be prevented from serving the space on a single fire activation signal via a smoke damper. Upon activation of the alarm, all lifts shall descend to their home floor. Unless a detector within that immediate zone is in alarm, in which case the lifts shall travel to the next safe floor.

12 Secure doors/portals on the general escape routes shall failsafe open.

13 Sounders and beacons shall activate to notify evacuation is required.

11.5 Emergency Power Off – EPO Strategy

01 A complete EPO system is to be provided that will enable electrical systems to be isolated in line with the fire brigade's requirements. Refer to the fire alarm schematics for the principles of the EPO system that is to be implemented. The EPOs are to be located in a central location near the entrance to enable the fire brigade shut off the power to the affected area remotely. The EPOs are to be provided generally as indicated in the following table:

Name	Point of Installation	Equipment Activated
Power module '#' EPO	Security Back Office	MV.DB.X.#.A – shutdown of transformer via transformer breaker on RMU IT UPS – Shut down of IT UPS and associated batteries Mech UPS – Shut down of Mech UPS and associated batteries. Generator '#' - shutdown
Generator '#' EPO	On board generator	Generator '#' only shut down
HV/MV Substation EPOs	Security Back Office	Shut down of each switchroom
HV/MV Substation EPOs	HV/MV Substation	Shut down of each switchroom
PV system	Security Back Office	PV '#' Inverters and associated equipment.
Emergency lighting central battery	Security Back Office	

Name	Point of Installation	Equipment Activated
EV chargers	Security Back Office	

02 The EPOs are to be rotary type and protected against accidental operation. The power supply to the EPO control panel shall be from UPS distribution boards and shall be made from fire resistant material.

03 The following local emergency energy release buttons must be installed:

Local EPOs:

1. 1nos. EPO button per generator container
2. 2no. EPO buttons for the HV/MV substation (1no. for each switchroom – to be coordinated with HV/MV substation specialist Contractor)

Security Back Office:

3. 6no. EPO buttons for each Power Module main LV switchboard associated with each data hall (shutting down strings A, B, C, D, E & F)
4. 1no. EPO button for each admin building LV switchboard serving the PV panels
5. 2no. EPO buttons for the HV/MV substation (1no. for each incoming supply – to be coordinated with HV/MV substation specialist Contractor)

04 PLC controls shall be used to allow for total power shutdown. When one of the Power Module EPO's in the security back office is operated, the PLC system in the relevant Power Module shall enable a total power shutdown.

05 Inside the security back office of the admin building, the electrical installer will be responsible for the supply and installation of a EPO mosaic/display panel with LED lights for the identification of the type of service and area released from the individual buttons installed in the building itself and the relative electrical panel serving the releases. The system will consist of actuators for the safe management of the release.

12.0 COMMUNICATIONS

12.1 IT / Telecoms

01 The intent is that the tenant will arrange, contract and install their own telecommunications services to their demise routed via the common provision from the Fibre Intake Room (FIR)/Point of Entry (POE) and the Meet Me Rooms (MMR) to the tenant's Data Hall.

02 The Contractor shall provide the full high level distribution containment system to convey the fibre to each of the data halls via the POE and MMR rooms as required.

03 Three room POE rooms shall be provided: POE 1 and POE 2 .

12.2 Network Providers

01 Network providers shall be provided as a turnkey project to the site by the employer.

02 Local carriers for the back-bone landlord services, shall be presented into the MMR by the general Contractor (GC).

12.3 Telco Rooms – MMR

01 The Contractor shall provide two diversely located rooms, which shall house the incoming telecommunication companies' equipment and networking devices that support the estate Wide Area Network (WAN).

02 Only one will be fully utilised with Client network and telecommunications services; the other shall be fully fitted out engineering wise and house alternate networks servers and racks.

03 Each room shall be provided with redundant power and cooling. Including the following:

1. Services to support 45 kW of IT load per room, via overhead open channel busbar;
2. Each room shall be provided with redundant cooling units.

04 The Contractor shall install a two-tier containment system. The "high" system shall convey cabling from the incoming fibre services from the sub slab ducts to high level within the room and then either shall terminate into a cabinet or via a high level containment systems hall transverse the room and drop to feed the sub slab duct and pit network that feeds the data suites and other areas.

05 The "low" containment system shall provide a means of interconnecting cabinets within the room and for low level interconnects.

06 Within the MMR room allow to provide play back board behind the fibre incoming ducts (terminating 450 mm AFFL) to mount transition boxes from fibre services where they do not terminate and transfer to internal fibre at the rack.

12.4 Cabling and Containment Provision to Data Halls

01 The Contractor shall provide a complete network of containment using overhead basket to the Data Halls.

02 Space shall be allowed for future installation of additional services from MMR 2 at high level. The Contractor shall allow for space for two 450 mm baskets, displaced by 1000 mm where possible from MMR to each Data Halls.

12.5 Tenant Installation

01 All IT and communication cabling within the Data Hall, including all cable containment, shall be provided by the tenant or the Employer.

02 IT cabinets and racks shall be provided by the tenant. In order to maintain optimum cooling performance and minimise PUE, the tenant is required to ensure all IT cabinets / racks are installed in hot aisles and are fitted with aisle containment to industry standard good practice. The Contractor shall ensure that services are coordinated to allow the later introduction of the hot aisle containment system.

03 Although the final rack layout is currently unknown, at Tender stage the Contractor shall account for the indicative rack layouts shown on the drawings.

13.0 ENGINEERING SITE COMMUNICATIONS

13.1 OVERVIEW

01 Development of ICT systems will be done during stage-4 design. The ICT System shall be equipped with the following ICT equipment / components.

1. Outside plant, containment
2. Backbone and structure cabling
3. Spaces & enclosures
4. Passive infrastructure (FOPP, FO patch cords, Rj45 Socket, Patch panels, UTP patch cords)
5. Active network infrastructure (Router, Switches, Firewall, Servers)

02 The ICT system will be designed to provide continuous operation with minimum downtime. The system's back up resources shall prevent communication impairment if a failure should occur.

13.1.1 Overarching Philosophy

01 The ICT system shall function efficiently under emergency conditions as well as in normal operations. All equipment shall be of modern, industrial, and field-proven design and will be from reputed and established manufacturers. Telecom system shall be heavy duty and reliable for continuous, unattended, and maintenance-free operation. The following principles will be adhered while designing the ICT system.

02 **Redundancy:** Systems designated, as redundant systems will be designed such that a single component or a single point failure shall not affect the normal operation and performance of the system with automatic changeover between the dual-redundant modules in the event of failure of equipment/module.

03 **Robustness:** A fault on one system shall not cause a fault or an abnormal condition on an associated system during the switching over to a standby or redundant circuit or system.

04 **Resilience:** The resilience of the system and equipment shall be such that any temporary loss of power or any other unexpected event shall not cause any system or equipment mis-operation or lock-up that requires manual re-setting, and system and equipment recovery shall be fully automatic without any manual intervention whatsoever it may be.

05 **Maintainability:** Components of the system shall be easily repairable, based on modular construction and user replaceable modules or cards. The equipment shall be easily accessible with standard service equipment.

13.1.2 Communication Outside Plan (OSP)

01 The communications outside plant pathways design includes the pathway systems to be implemented external to the main building and interconnecting to both existing building and future buildings. The information includes design requirements for communications vaults, duct banks and how these elements are affected depending on the scale of the site.

02 Telecommunications connectivity is facilitated through 2nos. POE room in the building (north & south). Site will have 4 separate property entrance points (tie in connection). Entry to the building will be via underground ducts.

03 North and south routes shall be separated by a minimum horizontal distance of 150m. The pathways shall be routed to enable the four IDFs in the facility to connect to both Entrance Rooms. Pathways shall be well protected against accidental damage and shall be accessible for cable installation, dressing, and future moves adds and changes.

04 6 no's of Separate ducts shall be provided for each TSP.

05 From the TSP manholes, multiple ducts shall be run over the plot on separate routes to the manholes immediately outside each building entry point.

06 From each manhole multiple ducts shall then be run to the corresponding POE within the building.

07 All ducts will be 110(OD) mm smooth internal sided uPVC, with large radius bends suitable for external grade fibre cables. All manhole cover shall be lockable with a standard padlock.

13.1.3 Communication Containment (Tenant) Strategy:

01 The Design shall provide a minimum of two secure network pathways dedicated to each POD (data hall), sized 150mm (H) x 450mm (W). One of the routes shall be designated as primary link, East, indicated with Red colour and second route shall be designated as secondary link, West indicated with Blue colour line. East and west routes shall be separated by a minimum horizontal distance of 20m. The pathways shall be routed to enable the four IDFs in the facility connect to both Entrance Rooms., East and West routes shall not cross unless separated by at least one floor and in different fire compartments.

02 ER Room (MMR 's) The ER rooms are located on the ground floor are physically separated by more than 20m. These rooms are to host the ISP providers. Each room there is 5 number of 45u rack.

03 There are four units of IDF Rooms at the Ground Floor where are in tenant's controlled leased spaces and contiguous to tenant data hall: IDF-1, IDF-2, IDF-3, IDF-4. They are connected to "East" and "West" ER rooms, via diverse routes.

04 Two 45u Rack are proposed for each TSP provider. Optical splitter module and patch panel modules are in two separate Rack frame.

05 One Rack is considered for DAS service.

13.1.4 Network Design

01 Project will have combined networks: IT Network, BMS Network and Security Network.

02 Dedicated LAN (Switch, patch panel) shall be provided for each the above system.

03 IT networks consist of landlord's voice and data networks such as IP telephony and Wireless Access Point. The primary server room for IT network is located at MMR -East, and the secondary server room is at MMR-West, both rooms are located at the ground floor.

04 Each room will have a 48U cabinet, 600 w x 1200d to house IT server, router, firewall, switch, patch panel, WAP controllers.

05 The BMS/EMS networks connect and manage various systems related to building facility support. All the BMS/EMS data outlet from the above equipment will be connected to the nearby BMS IDF rack. To ensure the redundancy, 2 runs of fibre optic cable will be implemented from MMR Rack to Each IDF.

13.1.5 Network Architecture

01 The network shall be a multi-layer, fault tolerant, unified fabric, Layer-3 site-wide TCP/IP network. The LAN hierarchy shall be based on three-tier architecture: access, distribution, and core. A high band width, multiple 25/10 Gigabit Ethernet 802.3ae shall be utilized for core layer interconnectivity. Likewise, dual 25-Gigabit Ethernet technology shall be utilized for interconnecting Core switches to Distribution Switches. A unified fabric switch shall be utilized in the Core (Layer 3) and Aggregation (Layer 2) to connect servers, Fiber Channel and Fiber Channel over Ethernet over common links. MLS Layer-3 Ethernet switches shall be utilized at the access (edge) layer to connect all field equipment (using auto sensing 10/100/1000 Base-T). Each MLS Layer-3 Access switch or stack of switches shall support multiple VLANs and shall be connected simultaneously to two different Distribution switches.

02 Quality of service (QoS), congestion management and multicast control, shall be implemented to manage real-time voice and video traffic as well as priority network data traffic. Other LAN services such as VLANs, Sub-netting, DNS, Proxies, Access Control Lists, DHCP and Routing Protocols shall be configured and implemented as part of the LAN solution.

03 Recovery mechanisms must be deployed as part of the network implementation and must be tuned to achieve less than 1 second recovery time. Unless noted otherwise, all core, aggregation and critical facilities access switches shall be inter-connected and configured so that there is not any single point of failure causing disruptions to LAN operations.

04 All network equipment shall be both IPV4 and IPV6 capable. While the specifications are based on IPV4, the Contractor, if directed by the Employer, shall implement IPV6 with backward compatibility to IPV4. Notwithstanding, the Contractor shall define all IP addresses static ranges and dynamic ranges as well as subnets and subnet masks. E. All internal network routing protocols shall be based on OSPF. External routing protocols shall be BGP.

13.1.6 Network Security Features

01 The switch shall support TrustSec and have the capability to tag packets with Scalable Group Tags (SGTs) and enforce access via SGACLs.

02 The switch shall support Encrypted Traffic Analytics (ETA), using machine learning to identify and take actions toward threats or anomalies in the network, including malware detection in encrypted traffic (without decryption) and distributed anomaly detection

03 The switch should support Trustworthy systems: Hardware anchored Secure Boot and Secure Unique Device Identification (SUDI) support for Plug and Play, to verify the identity of the hardware and software

04 The Switch should support Control Plan Policing (CoPP)

05 The switch should have Port security to secure the access to an access or trunk port based on MAC address to limit the number of learned MAC addresses to deny MAC address flooding.

06 The switch should support DHCP snooping to prevent malicious users from spoofing a DHCP server and sending out rogue addresses.

07 The switch should support Dynamic ARP inspection (DAI) to ensure user integrity by preventing malicious users from exploiting the insecure nature of ARP.

08 The switch should support IP source guard to prevent a malicious user from spoofing or taking over another user's IP address by creating a binding table between the Client's IP and MAC address, port, and VLAN.

09 The switch should support Unicast Reverse Path Forwarding (RPF) feature to mitigate problems caused by the introduction of malformed or forged (spoofed) IP source addresses into a network by discarding IP packets that lack a verifiable IP source address.

10 The switch should support Bidirectional data support on the SPAN, RSPAN and ERSPAN ports

11 The switch should support flexible & multiple authentication mechanism, including 802.1X, MAC authentication bypass, and web authentication using a single, consistent configuration.

12 The switch should support RADIUS change of authorization and downloadable SGACLs for comprehensive policy management capabilities.

13 The switch should support Private VLANs to restrict traffic between hosts in a common segment by segregating traffic at Layer 2, turning a broadcast segment into a Non broadcast multiaccess like segment to provide security & isolation between switch ports, which helps ensure that users cannot snoop on other users' traffic.

14 The switch should support Multidomain authentication to allow an IP phone and a PC to authenticate on the same switch port while placing them on appropriate voice and data VLAN.

15 The switch should support MAC address notification to allow administrators to be notified of users added to or removed from the network.

16 The switch should support IGMP filtering to provide multicast authentication by filtering out nonsubscribers and limits the number of concurrent multicast streams available per port.

17 The switch should support Secure Shell (SSH) Protocol, Kerberos, and Simple Network Management Protocol Version 3 (SNMPv3) to provide network security by encrypting administrator traffic during Telnet and SNMP sessions.

18 The switch should support TACACS and RADIUS authentication to facilitate centralized control of the switch and restricts unauthorized users from altering the configuration.

19 The switch should support Multilevel security on console access to prevent unauthorized users from altering the switch configuration.

20 The switch should support Bridge protocol data unit (BPDU) Guard to shut down Spanning Tree PortFast-enabled interfaces when BPDUs are received to avoid accidental topology loops.

21 The switch should support Spanning Tree Root Guard (STRG) to prevent edge devices not in the network administrator's control from becoming Spanning Tree Protocol root nodes.

22 The Switch should support IPv6 RA Guard, DHCPv6 guard, IPv6 Snooping to prevent any Man-in-middle attack.

13.1.7 Horizontal Cabling System

01 Horizontal cabling refers to the cable and pathways between the Communication Equipment Room and the field areas. Cabinet shall be installed inside Mechanical Gallery. Horizontal cabling shall follow star topology.

02 Horizontal cabling shall consist of continuous cable run from the network switch in the cabinet to the face plates in the work areas. Individual UTP Cat 6 cable runs from the network switch to the RJ-45 sockets shall not exceed 90 meters (295 ft). Security.

13.1.8 Backbone Cabling

01 Backbone cabling refers to the FOC connections between the following locations.

02 IDF/System cabinet in the designated Communication Equipment Room in MMR to Fibre Entry Rooms to establish telephony and data services via the Telecommunication Service Provider's network.

13.1.9 RJ45 Face Plate

01 Face plates will be flush, vertical and square to the wall panels. Face plate in the designated work areas within the building shall be wall/floor mounted type. Minimum separation of 5cm shall be maintained between the face plate and the floor. In rooms where faceplates are installed in floor outlet boxes, cables shall be pulled to the boxes via under floor service ducts.

02 Type of faceplates (i.e., wall/floor mounted), number of sockets (single/dual type), location etc. shall be finalized during detailed Engineering, based on the room arrangement.

13.1.10 Fibre Optic Patch Panel (FOPP)

01 FOPP shall be 19-inch rack mountable type. FOPP shall be suitable for terminating the fibre optic cable used for this project. The fibres in the cable shall be spliced to pigtails on trays provided in the FOPP. The connector side of the pigtails shall be secured with suitable coupler/through adapter provided as integral part of the FOPP itself.

13.1.11 Wi-Fi System

01 Dual Wireless Controller shall be provided.

02 Wireless LAN Controller

03 General requirements

1. The WLC should have Redundant Power supply.
2. The WLC should support 802.11ac Wave2 and 802.11ax.
3. The WLC should support centralized, distributed, and mesh deployments.
4. Each switch should support 802.1Q VLAN tagging for up to 4094 VLANs.
5. Wireless Controller shall support link aggregation and load sharing between Access Point to WLC links
6. Wireless Controller shall provide flexibility to run as standalone, LAN Switch Embedded or Router Embedded type
7. The Controller shall provide standalone Virtual Wireless Controller option without requiring physical, additional Controller appliance
8. The controller shall support hardware encrypted data plane between Access Point and Controller
9. The controller shall be proposed with complete feature set including licensed features
10. The controller shall support deployment flexibility without compromising any features
11. High Availability mode shall support controller inline data plane mode as well as local switching mode and Mesh mode
12. High Availability mode shall allow geographically dispersed installation between Controllers
13. The controller failover shall not trigger Client de-authentication and re-association
14. Heartbeat interval shall not be longer than 100msec
15. The controller shall support hot WLC software patching for fixing bugs
16. The controller shall support hot AP software patching for fixing bugs
17. The controller shall support new AP hardware without need for upgrading entire controller software.
18. The controller shall support rolling AP upgrade
19. The controller shall support rolling AP upgrade without need for clustering
20. The redundant Controller shall sync Access Point and Client Status, including DHCP IP lease status
21. Access Point shall be able to proactively distributes Client connection before and after association and tracking Client condition in real time using data packet RSSI

22. The controller shall support standard-based, secure AP-Controller data & control protocol like CAPWAP. protocol that has known vulnerability like PAPI cannot be used.
23. The controller shall support Inter-Controller Wireless Roaming
24. The controller shall maintain per-user Application usage and shall be able to export it for network analytic.
25. The controller shall support Multi Languages options from embedded GUI Management
26. The controller shall provide per-Client Connection Scoring and provide reasoning of Client Connection Score
27. The controller shall support Cellular offload using IPv6 tunneling to Mobile Core network
28. "The controller shall be able to support multiple RF Management profile per group of APs, including Transmit Power Control
29. and Dynamic Channel Assignment on both 2.4GHz and 5Ghz"
30. The controller shall be able to identify and avoid interferers with network performance impact analysis report
31. The controller shall support optimized, automatic channel width (20~160Mhz) selection over 5GHz, 802.11ac
32. Mesh AP nodes shall provide quick convergence and fast failover to new root mesh node
33. Mesh Backhaul interface shall support full duplex operation using wired daisy chaining
34. Mesh AP shall support fast roaming for Wired-Client through wired-to-wireless bridge Client
35. The controller shall support per-user and per-WLAN based application recognition and control that throttle usage by rate-limiting
36. The controller application recognition technology shall support exporting to 3rd party compatible format, such as NetFlow v9
37. The controller shall provide policy-based mDNS gateway including Chromecast gateway
38. The controller shall support new application signatures without upgrading controller software
39. The controller shall provide OS-level VoIP integration with Mobile Device, provides FMC (Fixed Mobile Convergence) solution
40. Access Point shall support Apple FastLane
41. Access Point shall be able to support 802.11r-based fast roaming and generic WPA2 devices under same SSID
42. The controller shall be able to prioritize Skype4Business call as a per-user Application prioritization policy.
43. Access Point shall defer off channel scanning upon activity of high priority traffic
44. Access Point should support Load-based Call Admission Control
45. The controller shall provide options to choose trusty worthy QoS tag from multiple sources (DSCP) and maintains priority tag over end-to-end network
46. The controller shall provide Device Profiling using multiple profiling methods to reduce false-detection

47. "The system shall provide secure onboarding service for both employee and guest based on standard-based security protocol
48. Proposed system shall not use public cloud as user data repository"
49. The controller shall be able to embed custom web portal page (HTML) to fully customize user experience without additional cost or extra box
50. The controller shall provide rule-based rogue classification and automatically run rogue mitigation action
51. The controller shall be able to detect employee device connection to Rogue Access Point and contain it automictically
52. The controller shall support Content Security using DNS integration, Web Classification shall be fully customizable
53. The system shall support control plane encryption on both IPv4 and IPv6
54. The Controller's image upgrade shall be done through secure, encrypted transport
55. The controller shall be able to provide unique pre-shared keys to the devices that do not support the 802.1x security protocol
56. The controller shall provide FIPS-140/CC certification, including certification pending
57. The controller shall support Identity PSK for on boarding
58. The controller shall support Umbrella integration
59. The controller shall support identification & mitigation of threats inside encrypted traffic
60. The controller shall support mapping of specific VLANs to single SSID, depending on Access Point location and user
61. The controller shall support automatic VLAN assignment per SSID to load-balance user connection.
62. assigned VLAN pool shall be same as number of available VLAN in the system"
63. The controller shall support embedded best practice configuration profile and setup
64. The system shall support monitoring and provisioning from Mobile App, supporting iOS and Android
65. The controller shall support packet fragmentation between Access Point and controller communication
66. The controller shall provide concentrator feature for all of telecommuter user and business traveller
67. The controller shall not have fixed regulatory domain setup to maintain single inventory for global deployment
68. The controller shall display the Client-side network information such as Client-RSSI, disassociation reason, etc.
69. The controller shall be able to display Apple iOS 11 or later version information.

13.1.12 Wireless Access Point:

01 The Access points should be controlled using an On Prem Wireless LAN controller or Cloud hosted Wireless controller.

02 Access point shall support both in-built and External Antenna options.

03 Access Point shall support assurance, packet capture, sensor capabilities

04 Access Point shall support application visibility and control

05 Access Point shall support encrypted traffic visibility

06 Access Point shall support integrated BLE5 radio

07 Access Point shall ship with metal-based mounting bracket for durability and reliability

08 Access point shall support PoE Injector option that support Multigigabit Ethernet speed

09 Access Point shall have integrated or external antenna

10 Access Point shall be Wi-Fi 6 certified, supporting 802.11ax on both 2.4GHz and 5GHz radio interfaces

11 Access Point shall support 802.11n and 802.11ac Wi-Fi standards.

12 Access Point shall support up physical layer data rates above 5 Gbps

13 Access Point shall support 802.11ax beamforming

14 Access Point shall be able to probe the network and provide with the deep data analysis to proactively fight rogue attacks or breaches.

15 Access Point shall support uplink/downlink OFDMA technology

16 Access Point shall be able to support Multigigabit Ethernet with uplink speeds of 100 Mbps, 1 Gbps, 2.5 Gbps and 5 Gbps

17 Access Point shall be able to support full features at 802.3at

18 Access Point shall be able to power up using PoE (.af)

19 Access Point shall support Dual 5GHz radios

20 Access Point shall support dedicated spectrum monitoring capabilities without compromising Client serving radios

21 Access Point shall support hardware driven beamforming

22 Access Point shall be IoT ready (Zigbee, Thread)

23 Access Point shall have 2GB or higher-sized DRAM for capacity and scalability

24 Access Point shall have 1GB or higher-sized Flash for capacity and scalability

25 Access Point shall be able to run Wireless Controller function within the AP

26 Access Point shall support proactive protection for RFI. It should accurately identify the source, location, and scope of RFI.

27 Access Point shall support Software Defined Radio.

28 Access Point shall support RF spectrum analysis.

29 Access Point shall support Wireless Intrusion Prevention System (WIPS)

30 Access Point shall support 802.11 Dynamic Frequency Selection (DFS)

13.1.13 IP Telephony System

01 The IP telephony system will be a dual server redundant system with voice mail and integrated with email and instant messaging. It will provide auto attendant and direct inward dialling. It will support IP phones in all areas where required. It will incorporate class of service and class of restriction with tenant billing information for international calls. IP phones will be allocated dedicated network ports with PoE.

13.1.14 Core Switch/Distribution Switches

01 Core Switch's shall be dual redundant, with the primary located in MMR-East and the redundant located in MMR-West. 25 GBps ports shall be provided for all up-link connections to the Distribution switches.

02 The switches should be able to cluster together for control and management plane functions.

03 The switch should support 10/25G Fiber ports.

04 The Switch should support Redundant Power Supplies.

05 The Switch should be capable of accomplishing Software Defined Networking with the following key protocols:

1. Using Locator/ID Separation Protocol (LISP) for Control Plane Coordination
2. Using Virtual Extensible LAN (VxLAN) for carrying Data Plane Traffic
3. Using Scalable Group Tags (SGT) for Policy Plane Enforcement

06 The Switch should be based on a Modular OS Architecture capable of hosting applications.

07 The Switch should have Front to Back Airflow system.

08 The Switch should have Multicore x86 CPU Architecture

09 The Switch should have a dedicated ASIC capable of handling VxLAN encapsulation and translations. This should NOT be done in software inside a general CPU.

10 The Switch should have IPv6 support in hardware, providing wire-rate forwarding for IPv6 networks

11 The Switch should support AES-256 with MACsec 256-bit encryption algorithm available on all models

12 The Switch should support a tamper-resistant, strong cryptographic, single-chip solution that provides hardware authenticity assurance to uniquely identify the product so that its origin can be confirmed to the equipment manufacturer. This provides assurance that the product is genuine.

13 The Switch should be Bluetooth ready, having the hardware support to connect a Bluetooth dongle to the switch to enable the use of this wireless interface as an IP management port interface. The port can be used for configuration and troubleshooting using WebUI or the Command-Line Interface (CLI), and to transfer images and configurations.

14 The Switch should support RFID, allowing the switch to have an embedded RFID tag that facilitates easy asset and inventory management using commercial RFID readers.

15 The Switch should support a Blue beacon, which is an LED for easy identification of the switch being accessed.

16 The Switch should have 1 x 10/100/1000 dedicated Ethernet Management Port

17 The switch should be able to be managed, controlled and monitored via centralized controller, for Software Defined Access architecture deployment.

13.1.15 Access Switches

01 Switches that shall be used for the access layer of the three data networks. The switches with 10Gbps uplink connectivity shall connect to the Core Switch. The high-density switches with 1Gbps downlink ports will connect all field devices. PoE/PoE+ capability is required to accommodate power requirements of field devices such as cameras, etc. The network switches shall also have dual power supplies and redundant connectivity to the aggregation switches to secure its high availability.

02 The switch should support 48 x 10/100/1000 Multigig ports and 1G ports on Multigig and 1G switches respectively.

03 The switch should support flexible stacking across 1G and Multigig models, allowing the ability to have a mix of 1G and multigig switches in the same stack.

04 The switch should support PoE+.

05 The switch should have the required power budget to power PoE+ devices on all ports.

06 The switch should support uplink module supporting 10G interfaces.

07 Switches should be stackable with up to 8 switches in a single stack.

08 The Switch should support Redundant Power Supplies.

09 Should support NSF/SSO in stack configuration

10 The switch should provide network virtualization and segmentation

11 The switch should support SDN

12 Should support YANG and Netconf

13 The switch supports the IEEE 802.1 AVB standard

14 The switches should be able identify encrypted malware traffic

15 The switches should support MACsec encryption standard IEEE 802.1AE

16 Switches should be able to do deep packet inspection on desired flow and able to classify application on the network

17 Should have native capability of providing Application Visibility and Control (AVC)

18 The switch should support layer-3 routing protocols RIP, Static, OSPF and BGP

19 The switch should support multicast: PIM-SM and PIM-SSM

20 The switch should support 4096 VLANs in accordance with the IEEE 802.1Q standard.

21 The switch should support Inter-VLAN Routing for IP version 4 and IP version IP version 6 traffic

22 Should support IEEE 802.1s Multiple Spanning Tree Protocol (MSTP)

23 Should support IEEE 802.1w Per-VLAN Rapid Spanning Tree (PVRST+)

24 The switch supports Dynamic Trunking Protocol (DTP), which manages trunk auto-negotiation on LAN ports.

25 The switch should support VTP Versions 1, 2 and 3

26 The switch should support Private VLANs

27 Switch should support both IEEE 802.3ad port aggregation

28 The switch should support IEEE 802.1x Authentication.

13.1.16 Switch Architecture

01 The Switch should support Redundant Power Supplies

02 The Switch should have dedicated Stacking module

03 The Switch should support power stacking – pooling the available power supplies from all the switches and makes the pooled power available to all of them.

04 The Switch should be capable of terminating wireless control plane from locally connected AP's.

05 The Switch should be based on a Modular OS Architecture capable of hosting applications.

06 The Switch should have RJ45 & Mini USB Console Ports for Management.

07 The Switch should have USB 2.0 for OS Management (uploading, downloading & booting of OS and Configuration).

08 The Switch should have Front to Back Airflow system.

09 The Switch should have Multicore CPU Architecture.

10 The Switch should have at least 1 10/100/1000 dedicated Ethernet Management Port.

11 The Switch should be Rack Mountable and should not take space more than 1RU.

12 The Switch should support Maximum Transmission Unit (MTU) of 9198 bytes.

13 The Switch stack should be based on Distributed forwarding Architecture, where in each stack member forwards its own information on network.

14 The Switch stack architecture should have centralized control and Management plane with Active Switch and all the information should be Synchronized with Standby Switch.

15 The Switch should support Stateful Switchover (SSO) when switching over from Active to Standby switch in a Stack.

16 The Switch stack architecture should be Plug & Play for attaching or removing any switch from the stack without any downtime.

17 The Switch stack architecture should allow the end user to stack 24 Port Switch with 48 Port of the same model.

18 The Switch stacking module should be hot-swappable.

19 The Switch stacking should support single IP address management for the group of switches.

20 The Switch stacking should support automatic upgrade when master switch receives a new software version.

21 The Switch stacking should support single configuration.

1. **Layer 3 Features**

   a) The Switch should support RIP, OSPF, EIGRP and Static Routing

   b) The Switch should support IPv6 Routing capable protocols in hardware.

   c) The Switch should support IP Multicast

   d) The Switch should support IPv6 Multicast Routing.

   e) The Switch should support basic IP Unicast routing protocols (static, RIPv1 & RIPv2).

   f) The Switch should support Inter-VLAN routing.

   g) The Switch should support HSRP for IPv4 & IPv6.

2. **Layer 2 Features**

   a) The Switch should be able to discover (on both IPv4 & IPv6 Network) the neighbouring device giving the details about the platform, IP Address, Link connected through etc., thus helping in troubleshooting connectivity problems.

   b) The Switch should support Detection of Unidirectional Links (in case of fiber cut) and to disable them to avoid problems such as spanning-tree loops.

   c) The Switch should support centralized VLAN Management, VLANs created on the core switch should be propagated automatically.

   d) The Switch should support 802.1d, 802.1s, 802.1w Spanning-Tree & its Enhancement for fast convergence.

   e) The Switch should support 802.1q VLAN encapsulation.

   f) The Switch should support 802.3ad (LACP) to combine multiple network links for increasing throughput and providing redundancy.

   g) Network Security Features

   h) The Switch should have Port security to secure the access to an access or trunk port based on MAC address to limit the number of learned MAC addresses to deny MAC address flooding.

   i) The Switch should support DHCP snooping to prevent malicious users from spoofing a DHCP server and sending out rogue addresses.

   j) The Switch should support Dynamic ARP inspection (DAI) to ensure user integrity by preventing malicious users from exploiting the insecure nature of ARP.

   k) The Switch should support IP source guard to prevent a malicious user from spoofing or taking over another user's IP address by creating a binding table between the Client's IP and MAC address, port, and VLAN.

l) The Switch should support Unicast Reverse Path Forwarding (RPF) feature to mitigate problems caused by the introduction of malformed or forged (spoofed) IP source addresses into a network by discarding IP packets that lack a verifiable IP source address.

m) The Switch should support Bidirectional data support on the SPAN port to allow the intrusion detection system (IDS) to take action when an intruder is detected.

n) The Switch should support flexible & multiple authentication mechanism, including 802.1X, MAC authentication bypass, and web authentication using a single, consistent configuration.

o) The Switch should support RADIUS change of authorization and downloadable Access List for comprehensive policy management capabilities.

p) The Switch should support Private VLANs to restrict traffic between hosts in a common segment by segregating traffic at Layer 2, turning a broadcast segment into a non- broadcast multiaccess like segment to provide security & isolation between switch ports, which helps ensure that users cannot snoop on other users' traffic.

q) The Switch should support Multidomain authentication to allow an IP phone and a PC to authenticate on the same switch port while placing them on appropriate voice and data VLAN.

r) The Switch should support MAC address notification to allow administrators to be notified of users added to or removed from the network.

s) The Switch should support IGMP filtering to provide multicast authentication by filtering out nonsubscribers and limits the number of concurrent multicast streams available per port.

t) The Switch should support VLAN ACLs on all VLANs prevent unauthorized data flows from being bridged within VLANs.

u) The Switch should support IPv6 ACLs that can be applied to filter IPv6 traffic.

v) The Switch should support Port-based ACLs for Layer 2 interfaces to allow security policies to be applied on individual switch ports.

w) The Switch should support Secure Shell (SSH) Protocol, Kerberos, and Simple Network Management Protocol Version 3 (SNMPv3) to provide network security by encrypting administrator traffic during Telnet and SNMP sessions.

x) The Switch should support TACACS and RADIUS authentication to facilitate centralized control of the switch and restricts unauthorized users from altering the configuration.

y) The Switch should support Multilevel security on console access to prevent unauthorized users from altering the switch configuration.

z) The Switch should support Bridge protocol data unit (BPDU) Guard to shut down Spanning Tree PortFast-enabled interfaces when BPDUs are received to avoid accidental topology loops.

aa) The Switch should support Spanning Tree Root Guard (STRG) to prevent edge devices not in the network administrator's control from becoming Spanning Tree Protocol root nodes.

bb) The Switch should support Wireless end-to-end CAPWAP-compliant DTLS encryption to make sure of encryption between access points and controllers across remote WAN/LAN links.

cc) The Switch should support IPv6 RA Guard, DHCPv6 guard, IPv6 Snooping to prevent any Man-in-middle attack.

dd) The Switch should support IPv6 RA Throttler for Wireless Implementation

ee) The Switch should support Dynamic VLAN, Downloadable ACLs, Multi-Auth VLAN Assignment, MAC Based Filtering & Web Authentication security mechanism.

ff) The Switch should support isolation of guest traffic from the enterprise by creating CAPWAP tunnels across a layer 3 topology between two endpoints.

gg) The Switch should support devices that need to resolve Wireless Internet Service Provider roaming (WISPr) and have support for captive portal bypass.

hh) The Switch should be capable of classifying and managing rogue devices.

ii) The Switch should be capable of using network intelligence to analyze wireless attacks and more accurately pinpoint and proactively prevent attacks (wIPS).

jj) The Switch should support Radio Frequency Grouping.

kk) The Switch should support enforcement of identity and context-based access policies for users and devices.

ll) The Switch should support ACLs based on HTTP Domain Names.

mm) The Switch should support software image update and switch configuration without user intervention.

nn) The Switch should support automatic interface configuration as devices connect to the switch port.

oo) The Switch should support system health checks within the switch.

pp) The Switch should support real-time network event detection and onboard automation.

qq) The Switch should be capable of being deployed by any installer at the site, without having any prior knowledge of the IOS CLIs.

rr) The Switch should support dynamic port and session configuration management.

ss) The Switch should support real-time network event detection and onboard automation in order to take informational, corrective actions when the monitored events occur (Embedded Event Manager).

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13.1.17 Server farm Switch

01 Redundant centralized server farms proposed to simplify server management, they do create problems from a bandwidth management perspective because the aggregate data rate can be extremely high.

13.1.18 Firewall

01 A redundant firewall is required to monitors incoming and outgoing network traffic and decides whether to allow or block specific traffic based on a defined set of security rules. The firewall shall meet the following minimum requirement:

02 Network attack detection, DoS and DDos protection, TCP reassembly for fragmented packet protection, Brute force attack mitigation, Zone-based IP spoofing, Malformed packet protection, protocol anomaly detection, Stateful protocol signatures, SHA Authentication, IP filtering, Network address translation, Java and ActiveX stripping AES 256, 3DES.

03 Firewall features:

1. Simultaneous deployment in transparent and/or routed mode.
2. Support for OSPF and BGP (v4 and v6).
3. Dynamic and static NAT.

4. Stateful fail-over/high availability.
5. Protocol inspection of all packets in all flows.
6. Ability to recognize and control a large range of applications.
7. Ability to control sub-applications or specific application functionality.
8. Ability to control applications by user or group.
9. Ability to control applications by risk level / business relevance.
10. Maintains performance while performing application control.
11. Custom application detection through open signature language.
12. Integrated site-to-site and remote access VPN support.
13. Integration with TrustSec and ACI.
14. Application identification includes business relevance and risk.
15. QOS and Rate limiting.
16. Gateway deployments should support L2 (transparent) and L3 with High Availability topologies. HA transitions should occur seamless with or without STP and react or ignore physical link state.
17. Able to be deployed in virtual cloud-based environments (VMware). Provide hypervisor-level security for inter-VM traffic between guests. Preserve security with zero downtime during virtual machine live migration.
18. IPv6 support should include Next Generation technologies such as IPS, Application Control and URL Filtering and Anti-Malware.

13.2 Tenant BACS Integration

01 The Tenant via a Controls Integrator shall deploy their own monitoring and alarming software systems, including the graphical user interfaces for the BMS and EMS systems and global dashboards, to create a management layer that provides their operations personnel visibility and provision to control and monitor all critical building systems.

02 BACS Supplier shall provide data points in MQTT Platform.

03 Whilst the Tenant Controls Integrator shall supply, engineer and configure their own management layer software, the Contractor shall be responsible for the provision of all system hardware, peripherals and network infrastructure to facilitate software deployment and its configuration as an integrated building control system. The extent of which is outlined in the EMS, BMS and BAS project specifications and on the project drawings.

04 The Customer does not wish to use the monitoring systems provided by the Contractor, but instead requires all EMS / BMS points to be mirrored to their own BMS / EMS via Serial interfaces. The Contractor shall be responsible for providing the necessary IP to RS-485 (Modbus RTU) and IEC 61850 to Modbus RTU optical isolators throughout the system, to ensure all points (see EMS and BMS points lists) are mirrored to the customers monitoring system. The Contractor shall make allowance for coordinating the addresses of points with the Customer for the integration to their system. For the EMS system, the Contractor shall also make an allowance for an HMI for the Modbus gateway.

05 The Contractor's scope of supply shall include the IP to Serial isolators, and the final connection to the Tenant's own Serial to IP convertor.

06 Whilst operating under a common management layer it is recognised that the critical building systems shall be controlled and monitored as a number of independent and discrete sub systems that each have stand-alone capability. Critical building systems where control and monitoring is undertaken by independent and discrete sub systems as part of their scope, include but are not limited to the following:

1. Chillers and pumps,
2. FWU,
3. CDUs,
4. Generators / switchgear.

07 Testing and commissioning up to and including site acceptance testing (ASHRAE Level 4) shall be undertaken using the stand-alone capabilities inherent within each sub system. Where the commissioning and demonstration of individual sub system(s) would be enhanced by the availability of management layer applications, for example; the graphical user interfaces being tested as part of point to point testing, alarm management software being available to confirm alarm routing, receipt and acknowledgement.

08 Although each of the critical controls systems shall function standalone, without reliance on any management layer application, the integrated systems testing (IST) (ASHRAE Level 5) shall take place once fully functional monitoring systems (BMS/EMS/BAS) and management layer applications have been installed, commissioned and demonstrated.

09 The tenant will be ultimately responsible for their Controls Integrator; however, the Contractor shall be responsible for the following:

1. Providing all hardware, network infrastructure and peripherals such that the Tenant Controls Integrator can deploy their software,
2. Develop and manage a programme, clearly identifying when the Controls Integrator is to attend site and the date for the IST for when the software shall be deployed,
3. Ensuring that the systems and site is ready for the Tenant Controls Integrator in accordance with the programme,
4. Procuring and deploying the relevant hardware in accordance with the Tenant Controls Integrator's specification,
5. Deploying and commissioning all the control systems as discrete fully functional standalone systems,
6. All enabling works to allow the Tenant Controls Integrator to deploy the management layer applications at a software level only,
7. Managing and coordinating the Tenant Controls Integrator's works.

13.3 Employer's Systems of Communication

01 The site operations team shall deploy the following:

1. Mobile phone repeater;
2. Radio repeaters;
3. Wi-fi access points.

02 The above systems shall be installed and commissioned by the employer's operations' team; however, the controls integrator shall ensure there is sufficient network capacity and containment to facilitate these installations.

03 The communication and network system that supports the above services shall be incorporated as part of the resilient Building Automation System (BAS) backbone network and shall connect to local access points and network switches.

14.0 SECURITY

14.1 General

01 The facility shall be provided with a thorough security provision to ensure access to all critical areas is restricted only to those with permission.

02 For the quality and workmanship requirements for security systems, refer to Black & White Project Documents.

03 The site shall be operated 24-7 and as such shall have 24-7 managed security staff.

04 All security equipment shall be provided with UPS supported and/or battery-backed power.

05 The Contractor shall appoint a single sub-Contractor to provide an integrated security and monitoring system.

06 All cabling and distribution shall be enclosed in steel conduit and trunking for the entire length of the circuit.

07 The design of the system and its cabling shall be resilient in both cable distribution but in the provision of main control, monitoring and recording equipment which shall be duplicated and mirrored such that there is an N+N control provision.

08 All security shall be controlled from the Security Operations Centre (SOC).

09 The scope of the Contractor's requirement for security provisions is outlined within the appendices of this specification, in the Security Responsibility Matrix. The following sections provide an overview of the security provisions.

14.2 Access Control

01 The Contractor shall provide a series of access-controlled doors, with solenoid locks actuated by the use of a valid credential (proximity card or biometric) or remote from the SOC.

02 Electronic Access Control or ACS provides the user with the ability to control and monitor the access of elements and zones of a building. The degree of control is usually determined by the final use of the space and in conjunction with the end user to ensure that the design caters to end user requirements in addition to ensuring a holistic security strategy.

03 The type of access control envisaged for the project will be through standard encrypted RFID cards, facilitated through an electronic access control system. The user will present the access card to the RFID reader, which will be linked to the door controller and strike/magnetic locks and door contacts. The system selected will provide the required hardware to remain fully functional in the event of a power failure. The system shall have the ability to provide a full audit trail and generate tailored reports based on operator requirements.

04 The strategic intent and functional requirement of the Electronic Access Control system is to:

1. Restrict access to authorised persons and vehicles.

2. Facilitate the controlled entry and exit of personnel with legitimate access rights into restricted and controlled areas.
3. Deter, detect, and delay attempts at unauthorised access.
4. Enable an authorised user to raise a discrete alarm warning of an access transaction while under duress; and
5. Support the security and search and screening regimes in preventing the introduction of prohibited and restricted items, and the unauthorised removal of items and materials.
6. Provide biometrics and dual-factor authentication within strategic locations throughout the site

05 Access of all people shall be strictly controlled and will also be physically separated to improve management and health & safety. Entry points into private and restricted space should be controlled to allow legitimate user to pass without undue effort or delay.

06 Access-controlled doors within premise shall be designed in accordance to the specification provided in the

07 Contractor shall further develop the security design based on Journey Physical Security Baseline for B-Class Facilities.

08 The type of access control devices shall primarily depend on the layer / zone where the access control system is required, and the credential / access configuration requirements shall be governed by the security clearance level.

09 Communication between all subparts of the system shall be over secure, encrypted means. Outdated, clear-text communication protocols and wiring standards shall not be used. Communication between the system devices shall be either via secure IP connections or encrypted serial wiring and protocols (e.g., OSDP over RS485).

10 The Access Control Servers shall be hosted in the redundant security equipment rooms located at MMR of the Admin building.

11 The ACS servers shall be redundant and shall be configured in duty/standby configuration with zero downtime.

12 The ACS shall be an enterprise class IP based solution capable of monitoring and controlling multi-disciplinary security sub-systems namely, Audio Intercoms, CCTV, Vehicle Barriers remotely from the security control rooms using the ACS workstation or the manual control unit.

13 The ACS shall be based on an open architecture and shall be able to support multiple access control hardware manufacturers. The ACS shall be able to integrate with multiple non-proprietary controllers, access card readers with OSDP protocol and other 3rd party applications.

14 The ACS shall provide a unified graphical user interface (GUI) to allow operators to control and monitor various aspects of security management system from the workstations to allow effective and efficient security management of the development.

15 The ACS shall be modular in nature and shall allow expanding the system in both capacity and functionality through addition of controllers, card readers, workstations, or by additional software license modules to cater to any future requirements.

16 The ACS shall utilise a multi-tier architecture with the ACS server and shall form the head end equipment. The workstations shall act as Client to the Access Control application. The communication between the ACS server and the workstations shall be standard TCP/IP and shall be 256-bit encryption.

17 The operator workstation in the Security Control Room shall comprise of a CPU and a monitor for monitoring and control of the access control system and carrying out system programming and configuration changes to suit the operational needs.

18 The access control panels shall be provided with in-built batteries to ensure continuity of operation at the main power failure for at least 4 hours. The panel for the controllers shall be sized such that they shall have space to accommodate battery size that Is capable of providing 4 hours back up.

19 All access control devices installed outdoors shall be minimum IP65 rated for protection from water jets and dust ingress. This shall apply to all external devices not limited to card readers, push buttons, locks, emergency break glass, intercom units, control panels, panic/duress buttons and other security devices shown on the layout drawings.

20 The panic buttons shall be installed underneath the work surface for the reception desks. They shall be weatherproof (IP65 rated) and easily accessible to trigger an alarm. 24. The ACS panels shall also be equipped with tamper switch to monitor the opening of the panels on the ACS workstations.

21 The entry/exit lane line to site & Vehicle screening area shall have gate barrier, induction loop and the audio intercom unit. It shall be free to exit, and the barrier shall open once the vehicle is detected in the induction loop.

22

23 The following areas shall have access control via proximity card for entrance at a minimum:

1. Front gate and barrier;
2. Pedestrian access to site;
3. Main building entrance;
4. Office floor entrance;
5. SOC;
6. FOC;
7. Meet me rooms;
8. POE rooms;
9. All Data Halls;
10. Access corridors to Data Halls (excluding man trap provision, in addition);
11. Intermediate corridors to allow segregation of phases of works;
12. Electrical plant rooms;
13. All lifts.

24 Request for Exit Devices (REXs shall be provided on all doors not provided with proximity card out readers. This shall be integrated into the locking device on the door.

25 The site shall be provided with an access control head end that shall allow cards to be programmed with different levels of access and an audit trail of card use.

26 Doors to the following areas shall be provided with alarm sounders:

1. Data Halls;
2. All exterior doors, with exception of the main entry/vestibule;
3. Loading bay entry;
4. Office corridors;
5. Staging Rooms;
6. Network Rooms;
7. MMRs;
8. POEs.

27 Door contacts shall be provided to all access-controlled doors, which shall be alarmed to the SOC and alarm sounders when not latched.

28 Entry and exit doors shall be programmed as follows:

1. Door held open time: 60 seconds;
2. Door held open warning time: 50 seconds;
3. The door readers shall be programmed to start beeping. No alarm will be generated;
4. Door relocks on opening;
5. Door unlock time, 5 seconds;
6. Door unlocks on fire alarm (dependent on fire alarm cause and effect);
7. Door shall not electronically unlock from secured side. The exit reader shall only authorize the exit event.

29 The access control system shall be integrated with the CCTV and video management system to provide the following functions:

1. In the alarm viewer, security officers shall be able to view the camera views of the alarm source by selecting the alarm:
   a) When available there shall be two camera views of the source. All alarm sources require at least one camera view;.
   b) There shall be two views from each camera. One live view and one looping five seconds before and five seconds after the alarm event.
2. In the event viewer, security officers shall be able to see a view from the best camera available:
   a) Two views from the primary camera. One Live view and one looping five seconds before and after the alarm event;
   b) From the site plan security shall be able to select all cameras, in order to pull up a live view.

30 Audio/visual intercom systems shall be provided at key access points to the site and building to assist with enquiries. These are to be provided.

31 All audio/visual units shall call the receiver within the SOC, where access shall be able to be granted from.

14.3 Controllers and Hardware

01 The ACS shall be an IP based distributed architecture to allow all access decisions to be made by the door controller for fast response to the card reader transactions.

02 The door controllers shall be installed in a suitable pre-wired enclosure in a secure area. The enclosure shall have separate trunking for power and control / communication cables to avoid any interference.

03 The access control panels, and intruder detection panels shall be equipped with the in-built battery backup for autonomous operation for a minimum period of 4 hours considering full load operation of the panel.

04 The batteries shall be installed inside the panels so as not to obstruct any panel component and it shall not be required to disconnect / remove the batteries for maintenance/ troubleshooting.

05 The controllers shall be equipped with the ability to save all transactions locally in its memory buffer when the communication with the server is lost and shall transfer these transactions to the server automatically when the connection is restored.

06 The panels shall be provided with forced ventilation depending upon the number of controllers, power supply units and batteries installed in the enclosure and shall be in accordance to the manufacturer's recommendation and standard industry practice.

07 The access control panel and intruder detection panels shall be monitored for AC power failure and Low battery alarm and shall generate high priority alarms on the ACS.

08 The access control panels shall be equipped with the tamper switch as standard and shall be monitored for generating high priority alarms on the ACS workstations for the security operators to take appropriate action.

09 The ACS software shall be based on an open architecture and shall be able to support multiple access control hardware manufacturers. The ACS software shall be able to integrate with multiple non-proprietary controllers, card readers and other 3rd party applications.]

10 The door controller shall link the other field hardware to the ACS server using standard TCP / IP protocol. All communication between the door controller and the ACS server shall be encrypted.

11 The door controller shall operate in a standalone and peer-to-peer mode in the event of communication loss with the ACS Server and shall have an internal buffer to store a minimum of 50,000 transactions in offline mode and transfer it to the server when the communications are restored.

12 Each door controller shall not connect to more than two independent card readers for performance reasons.

13 The door controller shall allow for the following connections at the minimum depending upon the type of lock.

1. Card Readers.
2. Door Contacts.
3. Electromagnetic Lock
4. Emergency Break Glass
5. Relay Outputs

14 If the door controller does not have sufficient auxiliary input/outputs on-board, additional IP based I/O module controllers shall be provided in ACS panels to monitor the other alarms from the IDS devices, tamper switch and panic buttons, etc.

15 The emergency break glass status shall also be monitored on the ACS workstation.

16 The ACS shall be compatible with all major card and access control technologies, including but not limited to:

1. Smart cards and readers
2. Biometric Readers
3. DESFire cards and readers

17 The readers shall be a OSDP compliant smart card reader supporting contactless 13.56 MHz smart card reader in a single unit containing the microprocessor / chip, antenna, audible and LED indicators.

18 The card readers installed in critical rooms like Security Control Room and Security Equipment room, Server Room, etc as shown on the layout drawings and shall support 2 factor authentication, e.g. Biometric + Card

19 The access card shall store the biometric template of the user on the card at the time of staff enrolment using the enrolment and validation reader.

20 The card reader and the smart cards shall operate at 13.56MHz frequency for Smart card for normal access-controlled doors and at the car park entrance.

21 The cards shall feature anti-cloning and anti-collision technology.

22 The locks shall be of electromagnetic type with the unsecure side electronically controlled. The locks shall be field configurable for fail-safe and fail-secure operation depending upon the project requirements.

23 The electromagnetic locks installed on staircase doors/emergency escapes routes shall be mechanically interfaced with the push bar/panic bar on the secure side.

24 The interface shall be mechanical and shall not require any signal from the fire alarm or the access control system to open the door from the secure side of the building.

25 The electromagnetic locks shall be supplied with all necessary accessories for proper installation of the lock, but not limited to the lock bracket, strike plate, cable, etc. The Contractor shall coordinate with the door supplier the installation methodology and the sizes of the lock accessories suitable for different types of doors.

26 The access control doors shall be interfaced with fire alarm system for automatic release in case of fire. The doors configured for automatic release (fail-safe) shall be in accordance with the approved fire alarm cause and effect matrix.

27 The integral signal from the locking device shall not be used to monitor the door status and separate door contacts shall be provided. The number of door contacts installed on each door shall depend upon the number of door leaves.

28 All doors shall have an emergency break glass to release the door in case of emergency.

29 The emergency break glass shall be connected to the access control system for monitoring and any activation of the emergency break glass shall trigger an alarm on the system.

14.4 Software – ACS

01 The Access Control System shall have the capability to integrate with security sub systems such as CCTV, intruder detection system, gate barriers and audio intercom system and HVM equipment.

02 The ACS shall support the following access control functionality at the minimum;

1. System Configuration.
2. Controller Configuration.
3. Cardholder Management.
4. Door and IO Management.
5. User Credential Management

03 The ACS shall provide a graphics user interface (GUI) to allow operators to interact with the system from the workstations in the Security Control Room (SCR) to effectively and efficiently monitor, control and manage security aspects of the development.

04 The ACS shall utilise a multi-tier architecture wherein the ACS server shall form the head end equipment and the workstation shall act as Client to the server. The communication between the ACS server and the workstation shall be standard TCP / IP and shall be encrypted.

05 The ACS software's operating system shall be fully multi-tasking multi-threading Microsoft Windows Server 2012 R2 (64-bit) or later as the relational database server.

06 The ACS shall support an unlimited number of audit trails, historical transactions (Event and Alarms) as per the requirement of the Employer and shall be limited only by the hard disk space available on the server.

07 The system shall be capable of maintaining entry and exit login details for all connected devices for at least on year.

08 The Contractor shall provide the full Software Development Kit (SDK) is provided for all parts of the access control systems which enables effective integration with any other systems.

09 The configuration of the ACS system shall be carried out from the workstation with appropriate user privileges.

10 The ACS workstation shall be used by the security operators to monitor and control the access control system, and all other sub-system interfaced with it.

11 The system shall only allow authorised users with necessary access rights to log on to the ACS workstation, to control and monitor the system.

14.5 Smart Card Reader

01 The card reader shall be contactless DESFire smart card readers and shall be installed on the doors identified on the security system layout drawings.

02 The smart card readers shall be compliant with the Open Supervised Device Protocol (OSDP) ensuring interoperability between the card reader and door controllers.

03 The reader shall be available for mullion mount and other options as required. The card readers installed external to a building entrance shall be vandal proof, waterproof (IP65) and rated for outdoor applications.

04 The card readers shall be flush mounted and shall be fixed to a suitable back box with tamper proof screws.

05 The card reader shall operate at 13.56MHz frequency range with read/ write capability and comply with ISO/IEC 14443 A/B standards.

06 The readers shall communication with the door controller using OSDP connection.

07 The card readers shall have LED's to provide visual indication for Access Granted or Access Denied conditions with different audible sound for each transaction. The card reader shall have a LED to indicate that the power is available to the reader and that it is operational.

08 The RF data transmission between the card and the card reader shall be encrypted using a secure algorithm.

09 The card reader shall read the sequential card number encoded on the card for making access control decisions.

14.6 Enrolment and Validation reader.

01 Enrolment and Validation readers shall be provided as part of the Badging Stations.

02 The enrolment reader shall capture and write the biometric template of each user to the access cards. The biometric template shall be stored on the card for safer and faster transactions.

03 The Validation reader shall be desk mounted unit capable of validating the biometric template and the cards for use prior to issue.

04 The enrolment & validation readers shall be connected to the access control system.

14.7 Intercomm

01 A complete IP based Audio Intercom system to meet the following requirements:

1. Bi-directional audio communication capability from the slave units installed at the car park entrances to the master station located in the security control room and the guard house.
2. Integrated with access control system to form part of a comprehensive security management system.

02 A complete IP based Audio Intercom system to meet the following requirements:

1. Bi-directional audio communication capability from the slave units installed at the car park entrances to the master station located in the security control room and the guard house.
2. Integrated with access control system to form part of a comprehensive security management system.

03 The entry stations shall be interfaced with the associated vehicle barriers for remote opening from the master stations.

04 The audio entry stations shall be IP based intercom system capable of full duplex communications. The intercom system shall be microprocessor controlled and modular in nature.

14.8 Fire Alarm Integration

01 The access control doors which are part of the fire escape / exit routes shall be interfaced with fire alarm system using hardwired contacts for automatic release of the access-controlled doors.

02 A control module shall be provided near each access control door to be integrated with the fire alarm system. The Contractor shall identify the fire escape routes based on the approved cause and effect matrix and coordinate the requirements with the fire alarm Contractor for automatic release of the doors.

14.9 CCTV Integration

01 The Access Control System shall be interfaced with the Video Surveillance System using a software interface at IP level. The integration shall allow for CCTV surveillance of the facility using the access control software interface and monitor alarms from the Video Surveillance System.

02 The operator shall have full control of the camera's functions from any ACS workstation.

03 The system shall allow the operator to view live video from within the ACS and be able to manually control the appropriate cameras from this view.

04 As a minimum, the ACS shall allow the configuration of the following CCTV functions directly from the ACS user interface.

1. Camera Pre-sets
2. Sequences
3. Patterns

05 The ACS shall be able to send the following commands to the Video Surveillance System to respond to a specific event/ alarm occurring on the access control system. As a minimum, these commands shall be, but not limited to:

1. Pop-up a camera stream in case of alarms in ACS system.
2. Switch the camera to a specific monitor.
3. Run a pattern of pre-defined coverage areas.
4. Run a sequence of pre-defined cameras.

06 The interface shall be capable of reporting motion detection and loss of video signal from any camera and raise an alarm in the Access Control System.

07 The ACS in conjunction with the Video Surveillance System shall be able to display live video signal together with the stored cardholder image upon presenting an invalid badge. Using the two images, the system operator shall decide to allow or deny access to the cardholder attempting to gain entry at the door.

08 The ACS shall have the capability to playback and export the recorded video by specifying the date and time, bookmarked videos, etc.

14.10 SOC Room

01 There shall be one SCR that will be integrated to all security systems via VMS Security Management System (SMS) interface or via Physical Security Information Management (PSIM) System:

1. Electronic Access control
2. Video Surveillance System
3. Security Intercom

02 Each Operator workstation shall be equipped with 3 monitors with the following configuration:

1. Monitor 1: VMS GUI displaying alarms, events and floor plans.
2. Monitor 2: Video playback, report generation and general administration work.

3. Monitor 3: Priority Cameras

03 The security Contractor shall configure the video feed on the large monitors as follows.

1. All cameras feeds shall be displayed continuously 24/7/365
2. All major or critical cameras stipulated in the regulation shall be displayed in the central monitor and shall be fixed view on 25fps at Full HD resolution on a single view/ tile and reduced 2048 p or 4CIF on a multi-tile setup.
3. All standard cameras shall be displayed continuously for a total cycle time does not exceed 60 seconds and number of matrix view does not exceed 6.

04 Security Control Room shall include the following.

1. A video display; with 8x55” monitors + decoder
2. Video wall workstations
3. A housing for the video wall workstations
4. 4 x VSS keyboard and mouse
5. 3 x 24” Desktop LED monitors, per workstation
6. 1 x Call for Assistance/Intercom Master Station
7. 1 x Event/Log printer h. 1 x Card Printer

14.11 Keylocker

01 The Contractor shall provide a key management solution fully integrated with the wider access control system.

02 The key locker shall be located within the SOC, and shall be provided with the following function:

1. Space to hold 100 keys;
2. No less than 150 tamper proof key rings;
3. Configured to require two valid proximity card readers to gain access to the locker;
4. Programmed so that the cardholder with checked out keys cannot exit the building;
5. Alarm on:
   a) Keys exiting the building;
   b) Keys checked out for over 8 hours.

14.12 Internal Closed- Circuit Television (CCTV)

14.12.1 General

01 The Contractor shall provide a complete IP CCTV system, incorporating cameras in key areas of the building and a video management system linked to events within the access control system.

02 The Contractor shall develop the CCTV system to the Client’s end requirements.

03 The CCTV system shall operate on the main fibre structured cabling backbone, with patch panels/network switches provided as required to serve the cameras in the field.

04 Final equipment wiring from the switches to the cameras shall generally be in dedicated trunking and conduit networks.

05 The CCTV installation shall be manufactured.

06 The Video Surveillance System (VSS) shall provide digital video capture, transportation, management, recording, live viewing, playback, and storage of the video. The VSS shall be based on capturing and processing Ethernet transmission of video signals from cameras. The entire VSS system shall be capable of being partitioned and allow sharing of selected video signals between Security personnel and other operational personnel as required.

07 The Video Surveillance System (VSS) shall be an IP/Ethernet based system and shall consist of video management, recording and archiving software, Power over Ethernet (PoE) IP fixed cameras and discrete cameras for indoor and outdoor use, camera housings and mounting hardware, and power supplies required to form a fully functional and operational network based virtual matrix surveillance system and network based digital video recording system.

08 As an optional feature, CCTV shall include Video Content Analysis (VCA) which shall apply automatic, persistent artificial intelligence to video signals in an effort to improve the efficiency of Operators by directing them immediately to events that need attention and provide them an easy way to determine the appropriate action.

09 Digital recordings for all cameras must be kept for at least 90 days.

10 The intended outcome of the VSS within the MIL05 project is to deter malicious intent and provide remote video surveillance to security operators in support of effective command and control leading to early detection and confirmation of, and rapid response to, security incidents. Moreover, second order objectives include:

1. Support site security through timely detection, monitoring and verification of actual and attempted crimes and other activity of security concerns.
2. Support possible response to incidents and post-incident investigation.
3. Support detection of hostile reconnaissance and other potential threats.
4. System wide capability to monitor, detect, observe, recognise, and identify persons of interest.
5. Capability to achieve smoke and fire detection as per local standards.
6. Retention of images for intelligence, investigation, and evidential purposes; and contribute to safety outcomes.
7. Deterrence of potential offenders through the presence of cameras and signs warning of camera coverage.
8. Reassurance of the public through the presence of cameras and signs warning of camera coverage.

11 The Video Surveillance System (VSS) shall be an IP/Ethernet based system and shall consist of video management, recording and archiving software, Power over Ethernet (PoE) IP fixed cameras and IP cameras with pan, tilt zoom (PTZ) features, panoramic, fisheye and discrete cameras for indoor and outdoor use, camera housings and mounting hardware, and power supplies required to form a fully functional and operational network based virtual matrix surveillance system and network based digital video recording system.

12 Due to the themed nature of the facility, the video surveillance cameras may feature paintable bezels and mounts. The domes shall be the smoked type. Any IR illuminators required for dark areas shall have an IR wavelength that is closest possible to invisible to avoid distracting the guests. Bullet type IP based video surveillance cameras may also be used – dependant on the situation.

13 The IP cameras for the front of house and landlord spaces shall be connected to the security network structured cabling system through CAT6A cables which are terminated directly in the security rack in the ICT room.

14 The electronic video surveillance cameras used for the food hall will be compliant with the following:

1. Identification (120%) body representation of 250 pixels/m.
2. Recognition (50%) body representation of 100 pixels/m.
3. Detection (10%) body representation of 20 pixels/m.

15 The following section outlines the minimum required locations required for CCTV locations:

1. All entrances to the establishment so that a person's image is within the identification view;
2. All main and secondary emergency exits leading inside or outside the establishment so that person's image is within the identification view;
3. All the lobby areas within the recognition view;
4. In the elevator lobby so that a person's image is within the recognition view;
5. All reception areas so that a person's image is within the recognition view;
6. Inside elevators within the recognition view with an angle shows the floor number, and using a lens with a wide angle so that it covers all parts of the elevator;
7. All emergency exit doors among floors within the recognition view;
8. All corridors within the site of Observation view;
9. All entrances and exits of parking lots within the view of reading plate numbers;
10. In the parking driveways within the detection view;
11. Outdoor cameras in the surrounding area of the building must be installed within the detection view.

16

14.12.2 Cameras

01 All cameras shall have back-up have redundant storage, in the form of onboard 64GB SSD cards.

02 All internal CCTV cameras shall be of Wide Dynamic Range (WDR) type with optimised infrared, zip stream capabilities, and shall achieve vandal rating for vandal protection or agreed equivalent.

03 Generally fixed wide-angle cameras shall be proposed.

04 All cameras located in corridors shall be defaulted to corridor format.

05 The CCTV, Access control and intruder systems shall be managed by a security management system platform which shall enable cause and effect capabilities in addition to operation of the video wall in the SOC.

06 The PoE demand of cameras shall not exceed 80% of the maximum ratings the associated switches.

07 Video Standards: H.265 / H.264 / MJPEG / HDSM technology

08 Image Standards: MPEG-4 - ISO/IEC 14496-10 AVC (H.264); MPEG-2 - ISO/IEC 23008-2:2013 (H.265)

1. Networking Standards:
   a) IEEE 802.3af (Power over Ethernet).
   b) IEEE 802.1X (Authentication).
   c) IPv4 (RFC 791).
   d) IPv6.
2. Interoperability Standards:
   a) ONVIF Profile S.
   b) ONVIF Profile T.
   c) ONVIF Profile G.
   d) ONVIF Profile M.

09 Camera shall support following encoding technologies:

1. Support compression and image quality settings from 1 to 20 to configure bandwidth utilized by the camera and desired image response. Provide user configuration of compression quality and image rate per camera.
2. Provide independently configured simultaneous H.264 and Motion JPEG streams (multi-stream).
3. Provide independently configured simultaneous H.265 and Motion JPEG streams (multi-stream).
4. Support Motion JPEG encoding in a selectable range from 1 up to 10 frames per second based on resolution configured.
5. Support H.264 encoding in a selectable range from 1 up to 30 frames per second based on resolution configured.
6. Support H.265 encoding in a selectable range from 1 up to 30 frames per second based on resolution configured.
7. Support Variable Bit Rate (VBR) in H.264 with a configurable maximum bit rate threshold.

10

14.12.3 Camera Configuration.

01 Fixed cameras shall provide min Full HD color images and be capable of 24/7 operation and maintain the required level of performance. All cameras will require recording for 90 Days at 25 fps.

02 There shall be a minimum 3 streams.

1. 20248 p @30fps for live
2. 2048p @25fps for recording
3. 2028p or 4CIF @ 30fps for remote live viewing and VMS and camera manipulation.

03 All cameras shall operate on a User Datagram Protocol (UDP over IP) or Transmission Control Protocol/Internet Protocol (TCP/IP) based transmission system or both where needed to support video streaming in a unicast environment or a multicast environment. The camera solution shall provide high-quality Full HD images of not less than a 1080p resolution on at least 2 video streams. The camera shall support Real Time Streaming Protocol (RTSP) and HTTPS/HTTP for configuration and video stream testing.

04 Camera devices shall operate via an Ethernet connection, where the power requirement for the camera devices is expected to be derived from the network system hardware as a Power over the Ethernet (PoE+) solution. The PoE+ solution shall meet appropriate Institute of Electrical and Electronics Engineer (IEEE) standards for power sourcing and cabling to ensure camera devices maintain performance requirements.

05 All cameras to have ultra-low light color, during hours of darkness the cameras shall be required to automatically switch from color to monochrome video output to ensure a seamless transmission of high quality of images. If the available ambient lighting is insufficient to ensure the minimum required performance for nighttime images, then appropriate infra-red-Light Emitting Diode (LED) lighting shall be required. This shall enhance the nighttime scenes and provide appropriate monochrome video images. This applies to both internal and external cameras where infra-red illuminators will be appropriate for each camera's field of view.

06 The perimeter of the premise shall be monitored via the video analytics incorporated within the cameras to provide necessary alarms. Thermal cameras shall be used. Borderline detection analytics functionality can be used to secure the perimeter. Event shall be triggered when specified number of objects have crossed the directional beam that shall be configured over the camera's field of View. The beam can be unidirectional or bidirectional.

07 Video Server shall support H.265 Video Compression to be considered for the VSS video compression.

08 Resolutions: All cameras to be min Full HD 2048 x 1536 pixels.

14.12.4 Video Streaming.

01 Dual encode and stream per channel: H.265, Full HDvideo.

02 Resolution and Frame rate and Bit Rate control per channel.

03 Max. IP Latency: 120ms. 4. H.264/H.265 encoding.

04 Video Server shall send alarm and event messages back to the video management system based on alarms and events generated on a per-camera basis.

1. Each message shall be configured as enabled or disabled.
2. The following table lists messages that shall be supported.
    a) Activity Alarm
    b) Activity Normal
    c) Video Signal Loss
    d) Video Signal Restored
    e) Camera connection lost
    f) Camera image blocked (in conjunction with similar feature in camera hardware/software)

14.12.5 Video Management System

01 The Video Management System shall be manufactured by Milestone, XProtect range.

02 The Contractor shall provide dual redundant Network Video Recorders (NVRs) for saving all video recordings, with storage facilities for the recording of all cameras for 90 days.

03 The following is required of the Video Management System:

1. Camera nomenclature shall be in a logical manner approved by the Client's security team;
2. The site plan shall be configured, so that operatives can select the camera they wish to view from a drawing of the facility;
3. A smart wall shall be projected onto the TV monitoring system in the SOC. The smart wall shall be configured to:
   a) Rotate through camera views sequentially;
   b) Bring up camera views after triggers, such as motion detected, or analytics alarms.

04 Two (2) four-hour training sessions on two separate days shall be provided to train the Client team on the video management system functions.

05 A single software option shall allow operator to control:

1. Multiple view matrixes in view live video, playback of recorded video from VSS Management and Recording systems,
2. IP cameras, gate barrier, security intercom and all related EACS (Access control alarms and monitoring systems).
3. Computer hardware from all supported manufacturers simultaneously.
4. Instant replay of recently recorded video at delay of no more than 3 seconds.

06 Live and recording video viewing must support M-JPEG, MPEG-4, and H.265 video streams, with each connected camera able to be viewed in any of the supported formats, according to the capabilities of the camera.

07 The database server shall utilize reliable SSD drives for the operating system drive to protect against hard disk drive failures from interrupting system functionality.

08 The database server shall utilize a RAID6 or later for the operating system drive, providing additional up-time.

09 The database server shall be independent of the storage servers and must adopt distributed architecture to mitigate single points of failure.

10 Proposed VMS shall support video streaming in either Unicast or Multicast where only one must be chosen by security Contractor and coordinated with Operator/Client ICT team to ensure network configuration supports the chosen VMS configuration. Selection of Unicast or Multicast must be done as per best practices from VMS Vendor to ensure highest performance of VMS.

15.0 LIFTS

15.1 General

01 The contractor shall employ the services of a specialist lift contractor, who shall be responsible for providing the new vertical transportation systems.

02 The contractor shall obtain costs from three lift specialists and shall submit costs and technical submittals of all three lift manufacturers as part of their tender return.

03 The technical submittals shall include the best case (largest) lift that the lift specialists can accommodate within the lift shafts.

04 For the quality and workmanship requirements for the vertical transportation lifts, refer to Project Documents & Specifications.

05 All lifts shall be provided with access control.

06 The contractor shall refer to the lift data sheets for detailed overview of the requirements of the passenger and goods lifts.

15.2 Passenger Lift

01 The contractor shall provide one (1) passenger lift (870 kg) for the office building for the transportation of people and furniture to the first office areas.

02 Refer to the Project Documents and the architectural specification for detailed requirements.

15.3 Goods Lift

01 The contractor shall provide two (2) goods lift (5440 kg) for plant replacement.

02 Lift door clearance minimum 2.50m X 3.05m.

03 Lift car minimum 2.50m W x 3.05 m Deep.

04 Refer to the Project Documents and the architectural specification for detailed requirements.

16.0 MECHANICAL AND PUBLIC HEALTH SERVICES SYSTEM OVERVIEW

01 The following section provides a brief overview of the proposed systems for the new mechanical and public health services relevant to the scope of works defined within this specification. These are detailed further in subsequent sections and on the drawings:

1. Data Hall & LV/MV Power Module cooling system – Air cooled chillers shall provide chilled water, from a variable primary pumping system, to coils within the various fan wall units (FWUs) and (CRAHs), which provide cooling to the Data Halls and various electrical plant rooms;

2. Admin Block Heating & Cooling system - A variable refrigerant volume (VRF) system shall provide comfort cooling and heating, utilising heat pump units, to serve offices and meeting rooms via fan coils units within the ceiling voids;

3. Data Hall ventilation system - Mechanical fresh air and extract systems shall be provided by various air handling units, with ductwork distribution systems from the units to Data Halls etc, within the data centre;

4. Admin Block ventilation system - Mechanical fresh air and extract systems shall be provided by fresh air handling units, incorporating heat recovery, heating/cooling and humidification with ductwork distribution systems from the units to the Landlord and Tenant spaces within the Admin Block;

5. Toilet & shower areas ventilation system - Mechanical fresh air and extract systems shall be provided by air handling units, incorporating heat recovery, heating/cooling with ductwork distribution from the units to toilets and shower areas within the building;

6. Loading bay ventilation system - Mechanical fresh air supply and extract ventilation shall be provided to the loading bay, incorporating heat recovery, heating/cooling with ductwork distribution;

7. Mechanical supply and extract smoke ventilation systems - these shall be provided to all Data Halls, technical rooms and storage spaces in-line with FLS requirements;

8. Potable cold water systems shall be provided to the building via booster sets through a pipework distribution system;

9. Non potable water systems from onsite rainwater recovery system to serve bib taps, WC flushing and irrigation;

10. An above ground soil and waste disposal system shall be provided to serve the sanitary ware fittings within the building;

11. An above ground rainwater disposal system shall be provided to serve the main roof area of the computer centre – refer to Architectural specification for detailed description of this system;

12. An above ground rainwater disposal system shall be provided to serve the roof areas above office accommodation within the building refer to Architectural specification for detailed description of this system;

13. Various separate condensate disposal systems shall be provided to serve fan coil units and air handling units throughout the building and shall connect into waste systems;

14. Diesel fuel filling stations and pipework to serve the generators and fire suppression diesel pumps,

15. A Building Management System (BMS) and controls installation shall be provided to serve the various mechanical, public health and electrical services within the building;

16. Fire suppression systems in the form of pre-action systems shall be provided to serve the critical spaces throughout each building;

17. Flooded sprinkler systems shall be provided to serve corridors, Admin , storage rooms and mechanical equipment rooms in accordance with buildings permitted life safety scheme and the fire life safety report;

18. A fire hydrant/hose reel system shall be provided to serve the building as detailed on the drawings;

17.0 MECHANICAL SERVICES DESCRIPTION

17.1 Cooling Systems

17.1.1 Chilled Water System Overview

01 In order to support the IT load requirements, the mechanical cooling shall be undertaken by air-cooled chillers with free cooling facility located on the roof gantry. The air-cooled chillers shall provide “free cooling” for all year operation as far as the external ambient condition permits.

02 Chilled water delivery to the critical spaces shall be delivered via (N+2) air cooled chillers with integral variable speed chilled water pumps (15+2 for the 20MW block).

03 Each chiller shall be provided with a variable primary pump to distribute cooling water around the entire circuit.

04 Each chilled water system will be provided with N+2 buffer vessels. The buffer vessels are normally on-line with 100% flow provided through the buffer vessel under normal operating conditions. Thermal storage is therefore immediately available to the system on loss of electrical power to the chiller; there will be no time lag due to control valve modulation and the system will not experience any downstream transient conditions.

05 The chilled water system shall operate at 21/31°C flow and return temperatures.

06 The cooling water circuit shall be configured with resilient pipework distribution from the chillers to the Data Hall ring pipework and be complete with pressurisation unit connections etc.

07 The air-cooled chiller chilled water circuit comprises air-cooled chillers, pumps and ancillary equipment to provide chilled water from the chillers to the cooling water circuit. The chillers shall be located within a screened enclosure on the external plant gantry at roof level.

08 It shall be noted that the chiller manufacturer is responsible for providing the chiller and the associated variable primary pump either within the chiller.

09 The chillers shall be provided with all controls and associated pump controls to afford an integral package as defined in the Project Specification.

10 Located on the gantry shall be a GRP plant enclosure that shall contain ancillaries including BMS control panels, pressurisation units, side stream filter, vacuum degasser and dosing pot.

11 Control of the variable primary pumps shall be via several differential pressure sensors that shall be located along the Data Hall chilled water circuit to ensure that the worst pressure reading is captured.

12 In at least two strategic locations in the chilled water circuit loop a bypass provided with a 2-port valve shall be installed - and sized for the minimum turndown of the pumps and/or chillers - to respect the minimum flow requirements of the chiller.

13 All chilled water pipework will be thermally insulated and where at risk of damage will be provided with additional protection.

14 Any chilled water pipework routed within electrical spaces shall be avoided or limited. In case required to be away from electrical equipment and provided with drip trays and with point detection leak protection tape.

15 All aspects of the chilled water system shall be concurrently maintainable.

16 Trace heating shall be provided to all external pipework.

17 Leak detection shall be provided in critical areas as defined in the design documents.

17.1.2 Dat Hall Cooling Overview

01 As per L2L SOQ requirements, both low-density air-cooled racks and high-density Hybrid air/liquid cooled racks would be deployed within data halls.

02 Each Data Hall shall be cooled by Fan Wall Units (FWUs) providing cold air into the space, and Cooling Distribution Units (CDUs) providing cooled technology water to liquid cooled racks, per the below configuration:

Equipment Within MEP Gallery (per data hall)

Equipment	Quantity N+R	Cooing capacity at N (kW)	Cooing capacity at N+R (kW)	Total Cooling Capacity (kW)
6MW DH				
Fan wall units	12+2	296	254	3552
CDU	3 sets of (2+1)	969	646	5814
4MW DH				
Fan wall units	8+2	296	237	2368
CDU	1 set of (4+1)	969	775	3876

03 FWUs & CDUs shall be located within the MEP Gallery adjacent to the Data Hall, providing single sided cooling to the space.

04 Data Hall air distribution shall be via a flooded cold aisle system with hot aisle containment.

05 Cold air shall discharge from the Fan Wall Units into the flooded cold aisle and be drawn through the racks and into the hot aisle containment system. Hot air shall discharge into the ceiling plenum and return back into the MEP gallery.

06 100% of the FWUs & CDUs will be UPS supported.

07 The FWUs shall supply temperature-controlled air to data halls. The integral DDC controller shall modulate the PICV opening position based on reading of built in SAT sensor to maintain the supply air temperature setpoint.

08 Redundant Sensors provided significantly increase the operational reliability of a sensor system.

09 For each FWU, a dedicated differential pressure sensor shall be provided to monitor the differential pressure between adjacent hot and cold aisles within the data hall, and the DDC controller shall modulate the FWU supply air fan speed to maintain the differential pressure set point between the respective hot and cold aisles. The fan speed shall be limited to design conditions, as detailed in equipment datasheets, during commissioning. Under no circumstances, including all possible restart scenarios, shall

10 fan speeds be permitted to exceed design conditions.

11 FWUs shall be supplied with an airflow damper located on the Data Hall side of the unit to allow isolation of the unit during maintenance and replacement while the Data Hall is in operation.

12 Point detection shall be provisioned within FWUs units to detect leakage of the circulating water and trigger alarms to notify operators. Detection of water leakage shall not close the FWU's 2-port control valve or isolate/shutdown any part of the critical cooling system.

13 Positive pressure within data halls is maintained using fresh air handling units, ceiling void pressure sensor shall measure differential pressure between the Data Hall space and the ceiling void for monitoring purposes.

14 Air handling units shall be provided to positively pressurise the Data Hall and to serve the ancillary areas as necessary. Data Halls shall be maintained under a positive air pressure to ensure contaminates are not drawn into these areas. The Data Hall shall be constructed to ensure a high standard of air tightness is achieved, thereby providing a dust free environment. The Contractor shall include for air pressure testing Data Halls to ensure the required level of air-tightness is achieved.

17.1.3 LV/MV Power Modules Cooling

01 Power Modules shall be OFCI, and the mechanical services shall be provided within the Power Module by the Vendor. The Contractor shall be required to coordinate with the Module interface points providing chilled water and condensate drain provisions to align with the selected power module vendor requirements, and in-line with Stack's OFCI demarcation matix.

02 Cooling to the power module compartments shall be provided by N+1 CRAHs/FCUs to achieve design criteria, part of Vendor design.

03 Battery rooms based on Li- Ion Batteries are required to be cooled to a temperature to align with manufacturer recommendations , and will be provided with N+1 DX cooling units, part of the prefabricated power modules.

04 At the time of the submission of the Stage 3, the LV and MV Power Module Technical Submittals had not been finalised. The MEP design has been produced based on indicative services interface points between the GC scope and OFCI Vendor scope, the GC shall make an allowance to updates to be provided to the interface points shown in the design along with any pipework routing updates required.

17.1.4 MMR Cooling

01 Cooling to MMR shall be provided by N+1 CRAHs served from the chilled water network, to achieve design criteria.

17.1.5 Admin building Cooling & Heating Systems

01 Non-critical Administrative, facility support areas and back of house spaces will be provided with variable refrigerant volume (VRF) / DX systems. FCUs will be located locally within the spaces served with condensers serving the located on the roof.

02 Critical rooms within the Admin block, such as emergency management, PV, SER, electrical and network rooms will be connected to VRF system, however, will be provided with standby units to achieve 2N.

03 Combined heating and cooling systems shall be provided to Office areas & administration spaces within the Office block, in the form of high efficiency, heat recovery Variable Refrigerant Flow (VRF) systems.

04 The variable refrigerant flow (VRF) systems will be with heat recovery air-cooled condensing units headered in parallel on the roof, with 3 refrigerant pipes routed to branch selector units or equivalent system depending on final manufacturer selection. Heat recovery will allow simultaneous heating and cooling operation for indoor units. Each indoor unit can run in heating or cooling mode, independent of the modes in which other fan coil units are running.

05 The final detailed design of the VRF systems is a specialist Contractor design item, in accordance with the performance requirements detailed within the Project Documents.

06 The VRF heating and cooling installations shall include the following:

1. VRF indoor units complete with, as necessary, integral condensate lift pumps (if required).
2. Outdoor VRF units complete with proprietary mounting system with antivibration mounts/pads.
3. A centralised control package (controlling all individual VRF systems in the office area) with central controller complete with touchscreen user interface, and also interfaced with the BMS to provide as a minimum:
    a) Centralised time switch control of start and stop times for zoned (adjustable) indoor units to suit occupied hours;

b) Central control of all functions for each individual indoor unit;

c) Night set back temperature (adjustable) for all zones;

d) All units, both internal and external, to shut down on receipt of a fire alarm signal;

e) Fault indicator for indoor and external unit.

4. Interconnecting controls wiring between indoor, outdoor units, central controllers, wall mounted controllers, including associated containment (shared with pipework where appropriate);

5. Thermally insulated refrigerant pipework supported on cable tray to meet the manufacturer's recommendations;

6. Hard wired, wall mounted control unit to provide as a minimum for indoor units:

   a) Manual override for on/off control;

   b) Temperature control;

   c) Speed control;

   d) Heating/cooling mode control.

7. Wiring between VRF equipment and local power supplies provided by others.

07 The following ancillary installations shall be provided as part of other MEPH trade works, to complete the VRF heating and cooling installation:

1. Condensate pipework with re-sealing type, waterless trapped discharges to the foul drainage system (provided as part of the above ground drainage installation);

2. Power supplies to indoor and outdoor units and branch controllers (provided as part of the small power installation);

08 Each VRF system shall be a complete, proprietary, packaged system and a single Specialist Manufacturer shall provide all systems on the site.

09 Each VRF system shall be installed by a Specialist VRF Installer registered with/approved by the VRF Manufacturer.

10 The VRF Manufacturer shall confirm that the outdoor units are capable of providing stable operation at the following "extreme conditions":

1. Winter: -10°C dry bulb, 100% saturation (-8ºC used for heat loss calculations);

2. Summer: 40°C dry bulb.

11 Each indoor unit shall be able to operate at 3 speeds (low, medium and high) as a minimum.

12 Each indoor unit shall be selected with acoustic performance meeting the noise criteria of the space. Ductwork shall be provided with acoustic lining on supply and return.

13 After completion of the site installation and when preliminary commissioning checks have been carried out by the Specialist VRF Installer, the VRF Manufacturer shall set-to-work, regulate, calibrate and commission all VRF systems (under the instruction and supervision of the Specialist VRF Installer).

14 Air-conditioning to remote rooms such as guardhouses will be provided by local split DX units.

15 Local electrical tubular or panel heaters maybe provided in areas where no VRF system is used such as external plantrooms, or storage areas, to be controlled from a local thermostat to maintain the temperatures above 10°C.

17.1.6 Heating & Cooling – shell and core

01 No active heating and cooling equipment shall be installed within the Shell and Core areas.

02 Spatial provision within risers and roof plant compounds for pipework and external plant shall be included, to facilitate future fit-out installation of heat recovery VRF systems.

17.1.7 Air-Cooled Chiller Chilled Water Circuit

01 The air-cooled chiller chilled water circuit comprises air-cooled chillers, pumps and ancillary equipment to provide chilled water from the chillers to the cooling water circuit. The chillers shall be located within a screened enclosure on the external plant gantry at roof level.

02 It shall be noted that the chiller manufacturer is responsible for providing the chiller and the associated variable primary pump either within the chiller enclosure or on a separate skid that can be attached to the packaged chiller (it shall be noted that all efforts shall be made to locate the primary pump within the chiller enclosure).

03 The chillers shall be provided with all controls and associated pump controls to afford an integral package as defined in the BMS Project Specification.

04 Located on the chiller gantry shall be a GRP plant enclosure that shall contain BMS control panels, pressurisation units, side stream filter, vacuum degasser and dosing pot.

05 The 200 mm Ø primary chilled water flow and return header is located externally above the chiller gantry. From this header chilled water pipework shall run to serve all computer rooms, PCS rooms, RCS rooms etc.

06 Control of the variable primary pumps shall be via several differential pressure sensors that shall be located along the computer room chilled water circuit to ensure that the worst pressure reading is captured.

07 In three (3) strategic locations in the chilled water circuit loop a bypass provided with a 2-port valve shall be installed - and sized for the minimum turndown of the pumps and/or chillers - to respect the minimum flow requirements of the chiller. Please refer to the BMS specific specification for further details.

17.2 Ventilation Systems

17.2.1 Main Supply and Extract Ventilation

01 Air handling units (AHUs) shall be provided to supply and extract air to and from the data centre.

02 Data halls shall be pressurised to achieve +12.5 Pa within each space to prevent the ingress of contaminants relative to the adjacent spaces under normal operation. In the event of failure or maintenance mode, the data halls shall be pressurised to achieve minimum of +2 Pa.

03 The building shall be pressurised a minimum of +3 Pa relative to outdoors.

04 The data hall AHUs shall be designed to be as efficient as possible and shall include a mixing chamber to maximise any beneficial heat and humidity transfer from the return air and to minimise the fresh air electric coil size.

05 The AHUs shall be provided with electric frost coil, pre-filter, filter, DX cooling / heating coils and to provide temperature and humidity tempered air into the Data Hall, in line with the required design criteria.

06 The fans shall be a plug type fan with a backward curved impeller with non-overloading characteristics. Each fan shall be directly driven by an electronically commutated, permanently excited motor (EC motors) incorporating an inverter with full speed control functionality.

07 Each air handing unit shall be controlled and monitored by the BMS. Refer to the BMS Project Documentation for further information.

08 Data hall air handling units shall be provided with minimum 0.5N + 0.5N resilience with concurrently maintainable ductwork connection network.

09 Supply and extract air ventilation with heat recovery shall be provided to electrical switch rooms (LV and MV) as part of the vendor's scope of work.

10 Supply and extract ventilation shall be provided to ancillary areas, storage areas and corridors etc. The AHUs shall be located at roof level and routed through the building to serve the areas required. All units shall be fully weatherproofed and shall include raked tops for rain run-off.

11 All AHUs shall be fitted with appropriate anti-vibration mounts and appropriate support systems.

12 All ventilation systems shall be provided with appropriate acoustic attenuation to meet the noise level criteria.

13 Motorised fire rated smoke dampers shall be provided to all rooms as necessary to ensure the integrity of the fire compartment is maintained in the event of a fire incident in accordance with the permitted fire life safety design.

14 Motorised fire rated smoke dampers shall be provided to all supply and extract ductwork where they bridge/cross fire compartment walls in corridors in accordance with the permitted fire life safety design.

15 The design criteria outlines the supply and extract requirements for general areas.

17.2.2 External Plant Room Ventilation

01 External plant room shall be provided with a standalone supply air ventilation system.

02 Fresh air supply ventilation shall be introduced to the space via a ducted supply fan, connected to a wall mounted, weatherproof external louvre at high level.

03 Flexible connections shall be provided at the inlet and outlet of the unit.

04 Extract air shall be relief to atmosphere via weatherproof external louvre at high level.

17.2.3 Extract Fans

01 Dedicated extract systems shall be provided to the following areas: toilets, locker and shower rooms, loading bays and recycling storage, HV, MV&LV Switchrooms.

02 Extract air from toilet, showers and locker rooms shall be provided with twin extract fans, run and standby. All toilet extract shall be exhausted at roof level in line with local German standards and regulations.

17.2.4 Smoke Ventilation System

01 Smoke ventilation systems shall be provided following the local code requirements and project fire strategy including but not limited to:

1. Data halls.
2. Technical spaces as defined in fire strategy depending on file load: MMR & POE, electrical rooms / galleries.
3. Storage rooms larger than 25m2.
4. Smoke filters / Fire lobbies.

02 Smoke extract and make-up air fans shall be provided to each data halls. The connections onto each of the smoke extract and make-up air fans shall be via fire rated ductwork with motorised fire rated smoke dampers.

03 Smoke systems serving electrical rooms and galleries shall consist of extract fans, associated duct work, dampers and air outlets. Makeup air will be via motorised openings through external façade.

04 All “smoke filter room”, also known as fire protected lobby, shall be provided with a fire rated supply air fan to maintain +30 Pa positive pressure during the event of fire/emergency. The ductwork connection shall be fire rated. The system shall be designed and installed in accordance with the provisions of Ministerial Decree 30/11/83 and UNI 12101-6 standards.

05 The smoke ventilation systems shall be standalone.

06 Smoke extract ducts within data halls are to be terminated with extract grill above ceiling void, make air will be provided below ceiling via low level and ceiling level supply diffusers.

07 The motorised smoke dampers and ventilation systems shall be controlled via dedicated smoke damper control panel and monitored by the fire alarm and BMS. A cause and effect for the smoke ventilation system shall be produced to detail the damper and fan operations in the event of a fire. This shall be coordinated with the fire alarm cause and effect. Manual control override shall be provided.

08 Any smoke ventilation required within the building shall be appropriately fire rated to meet the requirements of all applicable regulations and technical standards.

09 Control panels serving the motorised smoke control dampers shall be located within the Data Hall MEP corridors or local in their respective adjacent corridor. Control shall also be interfaced with the building central fire control system.

10 A central smoke damper control panel shall be provided, which shall come complete with integral 72 hours battery backup for continued operation after a mains supply failure. Smoke damper panels shall be used to provide power to the motorised fire rated smoke dampers.

11 All control and power cabling shall be sufficiently fire rated to comply with the fire strategy and local standards.

17.2.5 Natural Smoke Ventilation

01 Admin block rooms with window openings to external atmosphere are expected to be naturally smoke vented post event of fire in accordance with UNI 9494. Automatic Opening Vents (AOV) are not required under local codes.

17.2.6 Generator containers ventilation

01 To mitigate hot air re-entrainment, all generator containers shall be provided with exhaust hood terminated at 1m above building or chillers level whatever is higher. Also, flues shall be extended 1m above hood level.

02 Both exhaust hood and flue are vendor’s scope of work, however, support/steel work shall be provided by the general Contractor.

03 Ventilation system within generator container shall be designed and installed by Vendor.

17.2.7 Humidification

01 Humidification control to Data Halls is not required based on the customer's liquid-to-liquid SOQ humidity range 5-80%.

17.2.8 Lift Shaft Ventilation

01 The Contractor shall provide ventilation from the lift shafts to atmosphere in accordance with the requirements of the EN 81, all applicable regulations and technical standards.

17.2.9 Admin Building Ventilation

01 Fresh air supply and extract ventilation shall be provided to Office areas & administration spaces within the Office block.

02 With the exception of plant serving the loading bay areas, and local smoke ventilation systems, all ventilation plant shall be located on the external plant areas at roof level.

03 Externally, ductwork shall be routed from the air handling units and extract fans, across the roof of the office block to vertical services risers running from roof level to Level 0. All external ductwork shall be thermally insulated and provided with cladding protection against UV and vermin damage.

04 Internally, supply and extract ductwork shall be routed within ceiling voids from the services risers to each individual occupied space.

05 Cross talk attenuators (to DW144) shall be provided on final supply and extract ventilation ductwork branches to meeting rooms and offices. Final attenuator selection shall be via the attenuator manufacturer to suit the required NR rating in the attenuated spaces and the adjoining spaces. The Contractor is responsible for providing acoustic data to support the final selection

06 Ductwork shall be provided with motorised fire/smoke dampers where passing through fire rated compartment walls and floors.

07 All internal supply ductwork shall be thermally insulated.

08 Volume control dampers shall be provided as detailed on the layout drawings to facilitate balancing of the ventilation systems.

09 All ductwork and associated ancillaries shall be provided and installed in accordance with the guidance of the Ministry of the Interior and the Fire Brigade Command with regards to fire prevention, and the UNI EN 15780/11..

17.2.10 Occupied Areas Supply and Extract Ventilation

01 Packaged heat recovery air handling units, with filters, fans, motors filters, DX cooling coil (c/w integral condenser), electric heating coil and controls shall be located at roof level in dedicated plant areas. Air handling unit shall provide tempered fresh supply air to (and extract exhaust air from) the office block as detailed on engineering drawings. Each AHU controller shall facilitate independent operation with timeclock function and shall be complete with a BMS interface for operational override control and fault monitoring.

02 The admin/office AHUs shall be designed to be as efficient as possible and shall include an enthalpy rotary wheel to maximise any beneficial energy recovery and humidity transfer from the return air and to minimise the fresh air coil size.

03 All units shall be fully weatherproofed and shall include raked tops for rain run-off.

04 All AHUs shall be fitted with appropriate anti-vibration mounts and structural support systems.

05 All ventilation systems shall be provided with appropriate acoustic attenuation to meet the noise level criteria.

06 Supply ductwork shall terminate to the back of ducted VRF indoor units within open plan areas and shall connect to ceiling mounted supply diffusers in cellular spaces.

07 Extract ductwork within open plan areas shall be routed to ceiling voids, terminating via “bellmouth” entries. Within cellular spaces, extract ductwork shall connect to ceiling mounted extract grilles.

08 A ductwork branch from the general extract ventilation system shall be extended to each tea point/break area, terminating with a ceiling mounted extract grille.

17.2.11 Toilet and Shower Areas Ventilation

01 Dedicated packaged heat recovery air handling unit, with plate heat exchangers, filters, fans, motors filters, electric heating coils, and controls shall be provided to all toilet and shower areas.

02 Within the communal toilet and shower areas, air shall be extracted via ceiling mounted grilles, ducted to roof mounted AHUs, complete with integral speed controller with timeclock facility and BMS interface for operational override control and fault monitoring. Air handling unit shall provide tempered make up supply air in the corridor area within the WC cores.

03 The WC AHUs shall be designed to be as efficient as possible and shall include a counter cross flow heat exchanger to maximise any beneficial energy recovery from the return air and to minimise the risk of contamination. Heat recovery bypass shall be provided for summer conditions.

04 All AHUs shall be fitted with appropriate anti-vibration mounts and structural support systems. Where units are to be located externally, they shall be fully weatherproofed and shall include raked tops for rain run-off.

05 All ventilation systems shall be provided with appropriate acoustic attenuation to meet the noise level criteria.

06 Motorised fire rated smoke dampers shall be provided to all rooms as necessary to ensure the integrity of the fire compartment is maintained in the event of a fire incident in accordance with the permitted fire life safety design.

17.2.12 Loading Bay Ventilation

01 The loading bay shall be provided with a standalone supply and extract ventilation system with heat recovery.

02 Mechanical Ventilation Heat Recovery unit (known as HRU or MVHR) shall be provided to supply and extract air to and from the loading bay. The unit shall be located at high level of the loading bay. Air intake and exhaust to the façade via weatherproof external louvres at high level.

03 The loading bay HRU shall be designed to be as efficient as possible and shall include a counter cross flow heat exchanger to maximise any beneficial energy recovery from the return air and to minimise the risk of contamination.

04 The HRU consists of bag filter, panel filter, plate heat exchanger, DX heating/cooling coil, supply and return fans

05 Fresh air supply ventilation shall be introduced to the space via the supply side of the HRU. Air grilles/diffusers mounted on the supply ductwork shall introduce the air into the space.

06 Air shall be extracted from the space via the extract side of the HRU. The extract ductwork shall terminate internally via a bellmouth entry.

17.2.13 Mechanical Ventilation – Shell and Core

01 Capped off supply and extract ductwork branch connections from the main ventilation risers shall be provided to the shell and core areas, for connection of future fit-out distribution ductwork.

02 Office plant sizing shall take into account any future shell & core areas.

17.2.14 Ductwork Distribution System

01 The supply and extract ductwork shall include volume control dampers, constant air volume (CAVs), motorised smoke dampers, fire dampers, plenums, grilles & diffusers, attenuators, bell mouths, insect meshes, test points and sensors as necessary to provide a full operational system.

02 The ductwork and installation shall be in accordance with all applicable codes and regulations and the Project Documents.

03 The supply ductwork, internal of the building envelope, shall be fully insulated in accordance with the Project Documents. All ductwork insulation in fire escape corridors shall be fire resistant in accordance with all local technical standards and regulations and present no additional fire risk to the corridor.

04 The supply and extract ductwork, external of the building, shall be fully insulated in accordance with the Project Documents.

05 Care shall be taken by the Contractor to coordinate the services to ensure sufficient space is allowed for supporting and insulating ductwork as per the Project Documents. Phenolic foam inserts shall be provided at each ductwork support in order to maintain the insulation vapour barrier.

06 All external ductwork, internal ductwork exposed to view and ductwork within plant rooms shall be insulated and provided with Aluzinc cladding secured with stainless steel straps as described within the Project Documents.

07 Connections for future phases (if any) shall be provided, as required, with a capped shoe or tee connection into the main duct and space provision for the duct extension.

08 Where ductwork penetrates fire partitions, motorised fire smoke dampers shall be provided to maintain the fire compartmentation of the space. Details of the motorised smoke dampers installation and fire damper installation in various partitions shall be provided for sign-off prior to installation.

17.3 Condensate Pipework

01 Condensate pipework shall be provided to collect condensate from all Fan Walls , CRAH units, terminal units and AHU coils. The condensate pipework shall be of material as described within the Project Documents.

02 Condensate pumps shall be avoided and only considered as a last resort. If condensate pumps must be installed, then they shall be provided with a common fault alarm to the BMS.

17.4 External Plant Colours

01 The Contractor shall include for painting all external plant, pipework and ductwork to any RAL colour required.

17.5 Pressure Independent Control Valves

01 The Contractor shall provide CRAH units with Pressure Independent Control Valves (PICV) and independent orifice plate valves.

17.6 PUE Calculations

01 The Contractor shall provide Annual & Peak PUE Calculations comprising the following as a minimum:

1. Annual PUE utilising the local ASHRAE weather station at:
   a) 100% Design IT Load
   b) 75% Design IT Load
   c) 50% Design IT Load
   d) 25% Design IT Load
2. Peak PUE utilising the ambient temperatures as determined by the Contractors CFD study operating on utility backed power at:
   a) 100% Design IT Load
   b) 75% Design IT Load
   c) 50% Design IT Load
   d) 25% Design IT Load
3. Peak PUE utilising the ambient temperatures as determined by the Contractors CFD study operating on generator backed power at:
   a) 100% Design IT Load
   b) 75% Design IT Load
   c) 50% Design IT Load
   d) 25% Design IT Load

18.0 PUBLIC HEALTH SERVICES DESCRIPTION

18.1 Water Services

18.1.1 Water Supply

01 The following domestic water systems will be provided to support the data centre facilities.

- Domestic hot and cold-water storage and distribution to welfare facilities for non-critical use.
- Non potable water supply from onsite rainwater recovery system to serve washdown bib taps, WC flushing and irrigation.
- Make-up water supply for Chilled water system.
- Fire water storage make-up to support wet fire-fighting systems.

02 Contractor shall install all below ground pipework up the entry point to the MIL08A building interface and extension within building.

03 Service and double check valves plus a solenoid valve with a pulsed water meter, complete with BMS interface to monitor water usage, shall be provided on the incoming mains.

04 All water service networks shall be provided with suitable chlorination and test points to monitor the water quality.

05 The domestic water installation will comprise a packaged booster pump set with a break tank, and distribution pipework to the various appliances delivering water at a pressure of 1.5 – 2.2Bar.

18.1.2 Water Treatment System

01 Treatment system consists of cartridge filters, anti-legionella, water softeners and chemical dosing unit, as shown on the drawings.

02 Treatment system is Contractor design portion CPD, stage 3 drawings show design intent only. System shall be designed, installed, tested and commissioned by a specialist Contractor.

03 It's Contractor responsibility to identify incoming water quality and select proper water treatment equipment to satisfy the following:

04 Domestic/drinking water quality as per local regulations.

05 Humidifier manufacturer minimum water quality requirements.

06 Chilled water make-up system minimum water quality requirements.

18.1.3 Washdown Bib-taps

01 Roofs, gantries, plant rooms and loading bays shall be provided with bib-taps for washdown purposes.
Note: foul water inlet gullies shall be provided (to be included as part of the civil engineering package) within the above-mentioned spaces and connected to the main foul water drainage system.

18.1.4 Fire tank

01 Separate municipal water line shall be provided to fill fire tank in 8 hours as per NFPA.

18.1.5 Water Storage tanks

01 Tank design

1. Design and fabricate tanks/cisterns in accordance with all applicable standards.

02 Domestic storage water cisterns

1. Ensure storage cisterns for domestic water purposes comply with all relevant codes and regulations etc

03 Workmanship

04 General

1. Store, handle and erect all in accordance with manufacturer's recommendations and relevant Standards.

2. Make due allowance for valves, fittings, access, etc., to accommodate insulation and weathering where indicated.

05 Protection and cleaning

1. Ensure adequate protection from damage and ingress of foreign matter to tanks and cisterns during storage, erection and commissioning. Thoroughly clean out all tanks and cisterns prior to site testing and commissioning.

06 Inspection and access

1. Install tanks and cisterns to allow internal and external surfaces to be easily inspected and cleaned.
2. The equipment and installation shall be in accordance with all regulations and technical standards

18.1.6 Cold water Workmanship

1. Install, test and commission systems to comply with EN 806-4 and equipment manufacturer's recommendations.
2. Construct the system to ensure it is safe and without risks to health and where applicable incorporate in the final design/installation recommendations given in HSG274 Part 2.
3. Install thermoplastics pipework in accordance with the relevant standards.

02 Connections to taps and appliances

1. Make final connections to taps and appliances

03 Installation of water meters

1. Install water meters in accordance with manufacturer's instructions and EN ISO 4064-5
2. Comply with the requirements of EN 14154-4 for additional functionality devices associated with Smart Metering.

04 Installation of pressure booster sets

1. Install, test and commission pressure booster sets in accordance with manufacturer's recommendations.
2. The equipment and installation shall be in accordance with all regulations and technical standards

18.1.7 Hot water

01 Workmanship

02 Installation and commissioning generally:

1. Install, test and commission systems to comply with equipment manufacturer's recommendations, EN 806-4 , and local Regulations or Byelaws;
2. Construct the system to ensure it is safe and without risks to health and where applicable incorporate in the final design/installation recommendations given in HSG274 Part 2;
3. Install thermoplastics pipework in accordance with all regulations and technical standards.

03 Connections to taps and appliances

1. Make final connections to taps and appliances.

04 Water heater installation

1. Comply with manufacturer's instructions and recommendations for the installation of heater;
2. Locate heater with adequate surrounding space for service and maintenance.

05 Installation and commissioning of thermostatic mixing valves

1. Install and commission thermostatic mixing valves and mechanical mixing valves in accordance with manufacturer's recommendations;
2. For TMV2 and TMV3 approved valves comply with the scheme's installation and maintenance;
3. documentation requirements;
4. For TMV3 approved valves comply with the scheme onsite testing requirements;
5. The equipment and installation shall be in accordance with all regulations and technical standards

18.2 Admin Building Water Services

18.2.1 General:

01 Backflow prevention equipment shall be fitted to all outlets and equipment as required to suit the appropriate local Water Regulations category of the outlet/equipment.

02 All final connections to outlets and equipment shall be complete with quarter-turn ball isolation valves.

03 Non-potable water shall supply WC flushing, refer to the civil package for further details.

18.2.2 Domestic Cold Water

01 The potable cold-water supply to the office area shall be fed from the building wide potable water supply. A water meter shall be fitted to the main supply branch to the office for consumption monitoring, linked to the BMS.

02 Each support building will be provided with potable and non-potable water provisions.

03 Domestic water shall be treated prior supplying fixtures, treatment system consists of cartridge filter, water softener and chemical dosing unit. Water treatment equipment shall be installed within DHW room; a space provision was considered within support building.

04 Supply branches to each wet area shall be complete with a solenoid shut-off valve (fail close) linked to an occupancy sensor within the area, to shut off the water supply during periods of non-occupancy.

05 Each wet space shall be provided with a distribution manifold, from the manifolds, distribution will take place in the screed or at floor level with multilayer pipes. Each connection from the manifold will be equipped with a shut-off valve.

18.2.3 Domestic Hot Water

01 Domestic hot water within the office block shall be generated via heat pump type calorifier which shall be equipped with electrical coil as a backup.

02 Calorifier will be housed within DHW room, air intake and expulsion will be ducted to the roof, ducts will be terminated with weatherproof cowls and insect screens.

03 A suitable hot water recirculation network sized in accordance with local regulations shall be provided.

18.2.4 Water Services Pipework

01 The Contractor shall make all necessary allowances for thermal expansion. All exposed pipework in public areas shall be installed using chrome plated pipework.

02 The Contractor shall make all submissions and obtain all necessary approvals from the Water Supply Authority for the domestic water system installation.

03 Pressure regulating valves shall be of the balanced pressure type, group one low noise, complete with pressure gauge and filter. Pressure regulating valves shall be installed strictly in accordance with the manufacturer's instructions (including but not limited to horizontal installation with spring vertically aligned).

04 Care shall be taken by the Contractor to coordinate the services to ensure sufficient space is allowed for supporting and insulating pipework as per the requirements of the Project Documents. Blocks shall be provided at each pipework support in order to maintain the insulation vapour barrier.

05 All external pipework, internal pipework exposed to view and pipework within plant rooms and areas shall be provided with Aluzinc cladding secured with stainless steel bands as per the requirements of the Project Documents.

06 All external pipework shall be provided with trace heating to prevent the pipework from freezing.

07 Connections for future phases shall be provided where required with a line size isolation valve located to minimise dead legs.

08 Where pipework penetrates fire partitions, a sleeved detail shall be provided to maintain the fire compartmentation of the space. Details of the installation in various partitions shall be provided for sign-off prior to installation.

09 Automatic air vents shall be provided at each high point on the pipework installation. Drain points shall be provided at each low point of the pipework installation.

10 Water services pipework shall not run within Data Halls or electrical plant rooms; however, where this is unavoidable the pipework shall be provided with drip trays and point leak detectors throughout their length.

18.3 Drainage Services

18.3.1 Foul Water Drainage

01 The gravity discharge from wet spaces on the upper levels shall be connected to sewage stacks which shall be vented at roof level. The stacks shall be routed through the building with access points on every floor and rodding eyes at each change of direction. The stacks shall be connected to drain points, at the structural slab level, prior to discharging to the below slab drainage.

02 Gravity drainage shall be used wherever practical to avoid the need for lifting stations and sump pumps, unless necessary.

03 Waste sewer pipes are designed to cater for the maximum flow and to achieve minimum proportional self-cleansing velocity.

04 Floor gullies should be provided in the MEP gallery as shown on the drawings.

05 In coordination with the fire subContractor, additional drainage outlets shall be installed and connected to pre-action testing valves.

06 External yard housing the generator containers and mechanical module shall be provided with heavy duty drain channels, which will be connected to fuel interceptors then to main rainwater network.

07 The following rooms shall be provided with heavy duty drain outlets:

1. Mechanical modules / ancillary plant.
2. Fire pump & valve rooms.
3. Water treatment rooms.
4. Pre-action room.
5. Water services room.
6. Loading dock.

08 For details of below ground waste water drainage, please refer to civil drawings.

18.3.2 Condensate Drain

01 Condensate drain shall be connected to industrial waste system by the means of waterless traps.

02 The design temperatures for the chilled water system are 21°C flow and 31°C return water temperatures. At these conditions, the potential for the formation of condensation is considered unlikely. However, each pair of fan wall units are to be connected to a floor drain that will be equipped with odour trap.

03 Condensate drain provisions are considered for MV & LV sections of the electrical modules; Contractor to verify against final selected module layout, for further internal distribution carried out by Vendor.

04 MMR CRAH units shall be provided with condensate drain connections and waterless traps.

05 AHUs shall be all connected to condensate drain network.

06 Condensate pipework shall, as a minimum, be laid to a fall of 1:100.

07 Condensate pumps shall be avoided and only considered as a last resort. If condensate pumps must be installed, then they shall be provided with a common fault alarm to the BMS.

18.3.3 Rainwater Drainage

01 A rainwater system shall be provided to serve the main roof of the building.

02 This section should be read in conjunction with the Project Documents relating to the rainwater system.

03 For details of rainwater drainage please refer to architectural and civil package.

04 No Rainwater drainage shall pass through critical spaces such as switchrooms, network rooms, tenant spaces or Data Hall spaces.

18.3.4 Mechanical Equipment Drainage

01 Gullies shall be provided in each mechanical plant room and routed to an appropriate foul stack.

02 Mechanical drains from dosing pots, side stream filters, etc. shall be routed to and discharge into the gullies in plant room.

18.3.5 Admin Building Above Ground Drainage

01 Above ground foul drainage shall be provided within the office block to all sanitary outlets, routed, via gravity, to the below ground drainage installation.

02 The diameters of black and grey water disposal pipes shall be calculated according to the units of discharge and flow rates as per UNI-EN 12056 requirements.

03 System shall include a combined soil and waste stack; siphons must be ventilated by means of separate vent stacks (secondary vent with 40mm minimum diameter). Vent stacks shall be executed with the same materials and methods as the drain stacks.

04 All drainage where possible will be by gravity, drainage systems shall achieve self-cleansing velocity at the design flow rate.

05 Drainage shall avoid routing through White/Gray space in all instances.

06 The foul above ground drainage installation shall be ventilated to atmosphere, all main SVP shall rise to the roof level and be terminated with vent cowl.

07 First floor drainage pipework shall be impeded within the screed, insulation layer beneath pipework shall be shaped to accommodate deeper installations if needed, with a maximum limit of 245mm (invert level + pipe diameter).

08 Gravity condensate drain system shall be provided to collect condensate from DX/VRF indoor units and AHU coils, all connections to be made via waterless traps. Condensate drain shall be connected to waste system.

09 Condensate & Drainage pipework shall, as a minimum, be laid to a minimum fall of 1:100.

10 Condensate pumps shall be avoided and only considered as a last resort. If condensate pumps must be installed, then they shall be provided with a common fault alarm to the BMS.

11 Access points shall be provided to all stacks on all floor levels to ensure the system is fully accessible for rodding. Access points shall also be provided on all horizontal drainage runs and at all changes of direction and/or changes in pipe size.

12 All sanitary appliances shall be connected to the above ground drainage installation via water sealed traps.

13 Gravity condensate pipework shall be routed from all VRF indoor units and shall connect to foul drainage pipework via waterless/resealing type traps.

14 All safety valve/overflows from electric water heaters shall be connected to the foul drainage pipework via tundishes and waterless/resealing type traps.

15 Floor gullies and shower gullies within the ground floor WC/Changing areas shall be connected directly to the below ground drainage installation.

18.3.6 Drainage Pipework

01 All exposed waste pipe work within public areas shall be finished in chrome plated copper.

02 Only flexible thick wall pan connectors shall be used for WC pan connectors and, all pipework shall be installed with even, consistent gradients.

03 The sanitation system shall fully comply with the requirements of Local Authority or the approved inspector. Additional access doors shall be provided for testing of branch sanitation and vent pipework.

04 Care shall be taken by the Contractor to coordinate the services to ensure sufficient space is allowed for adjacent services.

05 Where pipework penetrates fire partitions, a sleeved detail shall be provided to maintain the fire compartmentation of the space. Details of the installation in various partitions shall be provided for sign-off prior to installation.

06 Drainage pipework shall not, generally, be run within Data Halls or electrical plant rooms.

07 Drainage pipework running at high level within Data Halls and electrical plant rooms shall be provided with drip trays throughout their length and with point detection leak protection tape.

18.4 Foul Drainage Above Ground

18.4.1 Performance Criteria

01 Install pipework fittings and accessories to ensure that:

1. Appliances drain quickly, quietly and completely at all times without nuisance or risk to health;
2. Discharge is conveyed without crossflow, backflow, leakage or blockage;
3. Air from drainage system does not enter building;
4. Pressure fluctuations in pipework do not vary by more than plus or minus 38mm water gauge and traps;
5. Retain a water seal of not less than 25mm;
6. System can be adequately tested, cleaned and maintained.

18.4.2 Routes

01 Ensure pipe routes are shortest practicable, with as few bends as possible and no bends in wet portion of soil stacks, unless indicated otherwise on drawings.

18.4.3 Installation

01 Installation requirements include:

1. Install pipes, fittings and accessories in accordance with EN 12056-5;
2. Manufacturer's recommendations;
3. Obtain all components for each type of pipework from the same manufacturer, unless otherwise indicated;
4. Inspect components carefully before fixing and reject any which are defective;
5. Ensure cut ends of pipes to be clean and square with burrs removed;
6. Allow for thermal and building movement when jointing and fixing;
7. Form junctions using fittings intended for the purpose, ensuring that jointing material does not project into bore of pipes, fittings and appliances;
8. Avoid contact between dissimilar metals and other materials which would result in electrolytic corrosion;

9. Provide access covers and cleaning eyes as necessary in convenient locations, to permit adequate testing and cleaning of pipework;

10. Prevent entry of foreign matter into any part of system by sealing openings during construction. Fit all access covers and cleaning eyes as work proceeds;

11. The equipment and installation shall be in accordance with all regulations and technical standards

18.4.4 Connections Between Pipes of Different Materials

01 Plastic

1. Connect plastics pipework to pipework of other materials using approved connectors and methods in accordance with plastics pipework manufacturer's recommendations, to form a watertight joint.

02 Cast iron

1. Connect cast iron pipework to clay pipework using super sleeve adapters and in accordance with cast iron manufacturer's recommendations.

2. Connect cast iron pipework to clay/concrete sockets with bituminised yarn and 1:3 cement and mortar, neatly finished, to form a watertight joint and in accordance with the cast iron manufacturer's recommendations.

03 Copper

1. Connect copper pipework to clay/concrete sockets using a caulking bush (brazed on), bituminised yarn and 1:3 cement and mortar, neatly finished, to form a watertight joint and in accordance with the copper manufacturer's recommendations.

2. Connect copper pipework to cast iron sockets using a caulking bush (brazed on), bituminised yarn and an approved caulking compound, neatly finished, to form a watertight joint and in accordance with the copper manufacturer's recommendations.

3. Connect copper pipework to cast iron using purpose made copper to iron connectors and in

4. accordance with the copper manufacturer's recommendations.

04 Galvanised Steel

1. Connect galvanized steel pipework to cast iron sockets with bituminised yarn and molten lead, lead wool or an approved cold caulking compound and in accordance with the galvanized steel manufacturer's recommendations.

2. Connect galvanized steel pipework to clay/concrete sockets with bituminised yarn and 1:3 cement and mortar, neatly finished, to form a watertight joint and in accordance with the galvanized steel manufacturer's recommendations.

05 Waste Connectors

1. Join to traps as manufacturer's recommendations.

06 Trap Test Requirements

1. Ensure there is a retention of a minimum of 25mm water seal in every trap, and that no air is blown through the trap seal when performance is tested.

07 Access Points

1. Provide rodding and access points at all changes of direction to enable whole system to be maintained.
2. Provide square door type access points as indicated on drawings at foot of all soil and ventilation pipes and at any subsequent floor levels as indicated on the drawings and/or as directed by building control.
3. Where practicable, locate access points and horizontal anti-syphon pipes above fitment flood level a minimum of 1200 mm above the respective finished floor level.
4. In general, make WC connections to drain points and soil pipes via flexible connectors.
5. The equipment and installation shall be in accordance with all regulations and technical standards

19.0 FIRE SUPPRESSION SYSTEMS

19.1 Systems

01 The Contractor shall be responsible for all interaction, submittals and approvals with local authorities (e.g. Local fire brigade etc.) required to design, install, commission, and handover the fire suppression & detection systems.

02 The Contractor shall be responsible for obtaining all approvals required of the fire suppression & detection systems.

03 The fire protection & suppression system shall meet the requirements all relevant NFPA13 standards, and UNI EN 12845, UNI EN 12094, UNI EN 12259, UNI EN 14384 relevant to the systems detailed below and their uses.

19.1.1 Automatic Sprinkler Protection

01 The fire suppression system is a Contractor Design element (CDP).

02 The Contractor shall provide an automatic sprinkler system in accordance with NFPA13 and UNI EN 12845. The sprinkler system shall be designed to the relevant hazard classification detailed within NFPA13.

03 The sprinkler system shall comply with NFPA and all relevant Italian and statutory regulations.

04 Refer to the design criteria section and the design drawings for the type of automatic suppression systems required for each type of space.

19.1.2 Fire Hose Reels

01 The fire hose reel system is a Contractor Design element (CDP).

02 The fire hose reel system shall be designed in accordance with the local relevant standards & regulations

03 A dedicated fire hose reel system shall be provided to the building in line with all relevant local technical standards and regulations.

19.2 General Requirements

19.2.1 Standards

01 The installation of fire protection systems shall be provided in accordance with all applicable regulations and technical standards

02 The fire protection system is to be designed to NFPA standards as a minimum unless superseded by local regulations.

19.2.2 Installation

01 Pipes shall be clean and free from corrosion, stock rust and internal obstruction.

02 Sufficient space shall be made to allow pipes to be heat traced or insulated where required.

03 Where pipework cannot be fully drained through the main control valves, drain valves and plugs shall be fitted. Where low points are in inaccessible, they shall be extended to an easily accessible position and terminated with drain valve.

04 Pipe sleeves shall be provided where pipes pass through structure. Sleeves shall be of the same material as the piping and shall be cut to the correct required length at site with due allowance for the thickness of plaster and/or other finishes.

05 On completion of fixing, all pipe sleeve annular spaces shall be fire-stopped, in accordance with the local standards and the permitted fire life safety scheme.

06 Screwed pipe joints shall be made with proprietary jointing compound only. Screwed joints shall be thoroughly cleaned of all jointing material immediately after making. Union joints may be used on piping 50mm nominal bore and below in accessible positions only. Unions shall have two ground bronze conical seatings.

07 Flanged joints shall be installed at all major items of equipment and pumps.

08 Medium weight mild steel pipework shall be rolled grooved. Heavy weight mild steel pipework shall be cut grooved.

09 Where grooves are made on galvanized mild steel pipe the galvanising shall be made good with a suitable cold galvanising solution.

10 Signage to be in accordance with all applicable codes and regulations.

11 Each pump shall be provided with isolating valves and check valve.

12 Valves shall be secured in their required open/closed position with strap and padlock.

13 Pipework shall be provided with drain valves at low points. Exposed valves shall be of the lock-shield type and shall have plugged outlets.

14 All pipework shall be made of non-corrosive materials.

19.2.3 Electrical Supplies

01 Refer to the Electrical Project Documents for requirements relating to duplicate electrical supplies and cabling.

19.3 Automatic Sprinkler System

19.3.1 Overview

01 The sprinkler installation shall be carried out by an approved sprinkler Contractor.

02 The sprinkler system is a Contractor Design element (CDP)

03 The work shall be phased, and the Contractor shall allow for this in their testing and commissioning.

04 This element of the work shall be a Contractors Design Portion (CDP). Design, install, test, flush and demonstrate the sprinkler systems to meet the performance requirements stated within UNI EN 12845 inclusive of the latest Technical Bulletins and the requirements of the Design Team including the Base- Build Design Team, the Local Authority, the Clients Fire Insurers and all other technical manuals and guides applicable including but not restricted to the reference documents stated within the specification.

05 Only companies approved by the relevant local authority shall be considered as suitable to carry out the design and installation of the works.

06 Only equipment approved by the relevant local authority shall be installed. The Contractor shall take full responsibility for the design of the installation based upon the proposals shown on the Drawings. Obtain, at the appropriate time prior to installation of the works, the approval of the Building Control Officer, The Fire Insurers and all other interested parties.

19.3.2 General Requirements

01 The installed sprinkler system shall provide all components necessary for a complete and fully operational system including:

1. Dedicated incoming fire main (shared with the fire hose reel suppression system);
2. Suction tanks for the boosted sprinkler supplies (shared with the fire hose reel suppression system);
3. Diesel fire pumps and jockey pump;
4. Distribution pipes and range pipes;
5. Landing valves and zone subsidiary valves;
6. Alarm valve stations;
7. Sprinkler heads;
8. All pipeline mounted equipment including flow switches and valve monitors;
9. Power supplies up to the control panel isolator;
10. Control and signalling cable connections from alarm, subsidiary zone valves and switches to the main sprinkler panel.

02 All system components shall be provided in accordance with the Ruling Practice Specification.

03 Only equipment approved by the Ruling Practice Specification and entered on the current applicable list of approved automatic sprinkler equipment shall be used.

04 The feed pipes to connections which are to be extended as part of future fit out works shall be sized such that the sprinklers may be installed to any reasonable design without exceeding the maximum permitted hydraulic losses.

19.3.3 Welding

01 All welding shall comply with the requirements of either Class II, oxy-acetylene welding, arc welding. Length of welded outlets shall comply with UNI EN 12845.

02 5% of welds shall be subjected to radiographic examination to EN 1435 in accordance with the test and re-examination procedures.

03 On site welding is not allowed.

19.3.4 Valve Stations

01 The installation control valves and all necessary pressure gauges, test valves and accessories shall be provided as required by the Ruling Practice Specification to comprise a complete valve station for each sprinkler system or zone.

19.3.5 Subsidiary Stop Valves

01 Subsidiary (zone) stop valves shall be monitored by screw down diaphragm valves, to EN 13397, with interlocking key.

02 All valves shall have open and shut indicators.

19.3.6 Sprinkler Pumps

01 An electric driven jockey pump, complete with direct on-line starter panel, shall be provided in the fire pump room to make up small losses in the delivery trunk main.

02 The redundant diesel fire pump set shall be provided in the fire pump room.

19.3.7 Water storage tanks

01 Fire water storage tank shall be provided to support automatic sprinkler system and the fire hose reel suppression system. The tank shall be sized to support operation of both systems concurrently.

02 Water storage tanks shall be of a suitable type and be maintenance free for a period of 15 years.

03 Tanks shall be 'full holding' capacity and not be dependent on infill from the town's main.

04 Tanks shall have internal partitions to maintain a level of resilience during periods of maintenance, to prevent the draining down of the whole tank.

19.3.8 Testing and Commissioning

01 Carry out all tests and inspections to meet with the requirements of LPC Rules Automatic Sprinkler Installations incorporating UNI EN 12845 inclusive of the latest Technical Bulletin.

02 Carry out all tests required by the local authority giving adequate notice with regard to timing of tests etc.

03 Inspect and test the installation at agreed stages to ensure that the pipework is properly secured and clear of obstructing debris and superfluous matter and that all work which is to be concealed is free from defects before it is finally enclosed.

04 Carry out a low-pressure air test, to establish whether open ends are present, prior to carrying out a hydraulic test on completion of the installation, or sections thereof.

05 The hydraulic test pressure shall be 1½ times normal working pressure or 15 bar, whichever is the greater, and shall be for a period of two hours without significant loss of pressure.

06 Upon completion of the installation of the system carry out tests in the presence of all interested parties to prove to the satisfaction of the Engineer that the installation conforms to the required standards.

07 Keep a record of all tests carried out to include the following:

1. Date of Test;
2. Location and identification of pipeline;
3. Drawing Reference;
4. Method Test;
5. Test Pressure;
6. Result of Test;
7. Signature of operative carrying out test and Company.

08 Dry pipework shall be pneumatically tested to working pressure.

19.3.9 Certification

01 Any faults disclosed, such as permanent distortion, rupture or leakage, shall be corrected and the test repeated. A test certificate shall be submitted on completion of successful testing.

02 On completion of the entire installation, and satisfactory hydraulic testing, performance tests shall be carried out on the supplies to each control valve assembly. The tests shall include pump performance tests, where applicable. Pressures shall be recorded at the valve station for given flow rates for the hazard classification as listed by the Ruling Practice Specification.

19.4 Fire Hose Reel System

19.4.1 Overview

01 The fire hose reel installation shall be carried out by an approved sprinkler Contractor.

02 The fire hose reel is a Contractor Design element (CDP).

03 This element of the work shall be a Contractors Design Portion (CDP). Design, install, test, flush and demonstrate the sprinkler systems to meet the performance requirements stated within EN 671 & all other relevant technical standards, inclusive of the latest Technical Bulletins and the requirements of the Design Team including the Base- Build Design Team, the Local Authority, the Clients Fire Insurers and all other technical manuals and guides applicable including but not restricted to the reference documents stated within the specification.

04 Only companies approved by the relevant local authority shall be considered as suitable to carry out the design and installation of the works.

05 Only equipment approved by the relevant local authority shall be installed. The Contractor shall take full responsibility for the design of the installation based upon the proposals shown on the Drawings. Obtain, at the appropriate time prior to installation of the works, the approval of the local fire department, the Fire Insurers and all other interested parties.

19.4.2 General Requirements

01 The installed fire hose reel system shall provide all components necessary for a complete and fully operational system including:

1. Dedicated incoming fire main (shared with the automatic sprinkler system);
2. Suction tanks for the boosted sprinkler supplies (shared with the automatic sprinkler system);
3. Pumps and jockey pump;
4. Distribution pipes and range pipes;
5. Landing valves and zone subsidiary valves;
6. Alarm valve stations;
7. Hose Reels;
8. All pipeline mounted equipment including flow switches and valve monitors;
9. Power supplies up to the control panel isolator.
10. Control and signalling cable connections from alarm, subsidiary zone valves and switches to the main sprinkler panel.

02 All system components shall be provided in accordance with the Ruling Practice Specification.

03 Only equipment approved by the Ruling Practice Specification and entered on the current applicable list of approved equipment shall be used.

04 The feed pipes to connections which are to be extended as part of future fit out works shall be sized such that the system may be installed to any reasonable design without exceeding the maximum permitted hydraulic losses.

19.4.3 Welding

01 All welding shall comply with the requirements of either Class II, oxy-acetylene welding, arc welding. Length of welded outlets shall comply with the relevant technical standards.

02 5% of welds shall be subjected to radiographic examination to EN 1435 in accordance with the test and re-examination procedures.

03 On site welding is not allowed.

19.4.4 Hose Reel Pumps

01 An electric driven jockey pump, complete with direct on-line starter panel, shall be provided in the fire pump room to make up small losses in the delivery trunk main.

02 The redundant pump set shall be electrically driven and via a backup supply from the life safety generator.

19.4.5 Water storage tanks

01 A combined fire water storage tank shall support both the automatic sprinkler / pre-action system and the fire hose reel suppression system. The tank shall be sized to support operation of both systems concurrently.

02 Water storage tanks shall be of a suitable type and be maintenance free for a period of 15 years.

03 Tanks shall be 'full holding' capacity and not be dependent on infill from the town's main.

04 Tanks shall have internal partitions to maintain a level of resilience during periods of maintenance, to prevent the draining down of the whole tank.

19.4.6 Testing and Commissioning

01 Carry out all tests and inspections to meet with the requirements of LPC Rules Automatic Sprinkler Installations incorporating EN 671 inclusive of the latest Technical Bulletin.

02 Carry out all tests required by the Building Control Officer or equivalent giving adequate notice with regard to timing of tests etc.

03 Inspect and test the installation at agreed stages to ensure that the pipework is properly secured and clear of obstructing debris and superfluous matter and that all work which is to be concealed is free from defects before it is finally enclosed.

04 Carry out a low-pressure air test, to establish whether open ends are present, prior to carrying out a hydraulic test on completion of the installation, or sections thereof.

05 The hydraulic test pressure shall be 1½ times normal working pressure and shall be for a period of two hours without significant loss of pressure.

06 Upon completion of the installation of the system carry out tests in the presence of all interested parties to prove to the satisfaction of the Engineer that the installation conforms to the required standards.

07 Keep a record of all tests carried out to include the following:

1. Date of Test;
2. Location and identification of pipeline;
3. Drawing Reference;
4. Method Test;
5. Test Pressure;
6. Result of Test;
7. Signature of operative carrying out test and Company.

08 Dry pipework shall be pneumatically tested to working pressure.

19.4.7 Certification

01 Any faults disclosed, such as permanent distortion, rupture or leakage, shall be corrected and the test repeated. A test certificate shall be submitted on completion of successful testing.

02 On completion of the entire installation, and satisfactory hydraulic testing, performance tests shall be carried out on the supplies to each control valve assembly. The tests shall include pump performance tests, where applicable. Pressures shall be recorded at the valve station for given flow rates for the hazard classification as listed by the Ruling Practice Specification.

19.5 Fire Hydrants

19.5.1 Scope

01 This section should be read in conjunction with the Project Documents relating to the Fire Hydrant System

02 The fire hydrant system is a Contractor Design element (CDP).

03 Design, procurement, installation, testing and commissioning of fire hydrant system, complete with pumps, tanks, fire hydrant, piping and accessories.

04 The system comprises fire pump set, tanks, fire hydrant, piping and accessories.

05 The Contractor shall carry out verification of the full system hydraulic calculation by means of an approved software and submit the same for approval prior to any procurement/installation.

06 For more information please refer to Lombardini22 project documents and below ground mechanical service drawings.

07 The fire hydrant system shall be designed, inspected and tested in accordance with the following standards:

1. All relevant UNI standards as outlined further on;
2. UNI EN 14339, Underground fire hydrants;
3. UNI EN 14384, Pillar fire hydrants.

19.5.2 Locations

01 A fire hydrant system shall be provided to the site.

02 The fire hydrant system is a Contract Design element (CDP).

03 The fire hydrant tank and associated electric pumps shall be located externally. Please refer to external site wide service drawings for further information.

04 Fire hydrants shall be positioned in accordance with all applicable codes, regulations and technical standards.

19.5.3 Surface boxes

01 Hydrant surface box frames shall be provided with lifting key recesses and two loose keys to EN 124.

19.5.4 Water supply

01 The water supply shall be capable of operating in accordance with all relevant codes, regulations and technical standards.

19.5.5 Fire Pumps

01 The pumps shall be supplied with the specified drivers, controls, control panel, and pump accessory items by the pump manufacturer. The pump, driver and control shall be listed for the fire protection services and; Underwriters Laboratories (UL) Listed and Factory Mutual Research Corporation (FM)

02 The fire pump shall also be capable of delivering not less than 150% of rated flow at not less than 65% rated head. Pump manufacturer shall have unit responsibility for the proper operation of the complete unit assembly as indicated by field acceptance tests.

03 Fire pump shall be of horizontal centrifugal construction specifically labelled for fire service.

04 The pump shall be connected to the sprinkler system via stainless steel piping network. The suction supply for the fire pump shall be from a storage tank, that is directly fed from the water mains. The pump casing shall be cast iron

05 Factory Acceptance Tests: Each individual pump shall be hydrostatically tested and run tested prior to shipment. The pump shall be hydrostatically tested at a pressure of not less than one and one-half times the no flow (shut off) head of the pump's maximum diameter impeller.

06 The pumping equipment shall be installed as recommended in the National Fire Protection Association (NFPA) Pamphlet 20, Standard for the Installation of Centrifugal Fire Pumps. than 65% rated head. Peerless Pump model shall be furnished with driver, controllers and accessories as detailed in this specification. Pump manufacturer shall have unit responsibility for the proper operation of the complete unit assembly as indicated by field acceptance tests.

19.5.6 Fire Hydrants

01 All Fire Hydrants shall have a pre-approval from local authority for intended use.

02 Hydrants shall be U/L Listed or LPCB approved and shall have local authority approval.

03 Hydrants shall be supplied and installed complete with removable/replaceable nozzles.

04 Hydrants shall be rated for working pressure of the Hydrant shall be 14 Bar and shall have been tested for 28 Bar.

05 Hydraulically farthest hydrant shall deliver the design duty as required by local codes and regulations.

19.5.7 Resilience

01 The pumps shall be arranged to provide 2N (acting-standby) resilience.

02 Both duty and standby pumps shall be diesel type.

20.0 CUSTOMER FITOUT

01 The Contractor shall refer to Stack's Customer Interface documents for the fit out scope split in customer areas.

02 The Contractor shall make provision for the following:

1. Lighting provision as indicated on the drawings and complete with a DALI daylight harvesting / occupancy sensor lighting control system.
2. VRF heating and cooling to the entire office area on Ground Floor and First Floor.
3. Ventilation throughout based on occupancy density in accordance with the local regulations:
   a) 0.12 person per 1 m² for operational office areas;
   b) 0.06 person per 1 m² for cellular office spaces;
   c) 0.6 person per 1 m² for meeting rooms.

4. Fire detection to the relevant standards throughout the ground and First Floor offices and generally as indicated on the drawings.

5. Power and data provision to each two desks is based on a provision of 3 compartment floor boxes (Final floorbox provision to be agreed with the Client and Tenant prior to installation):

   a) Compartment 1: 2 x 10A socket

   b) Compartment 2: 2 x 16A socket

   c) Compartment 3: 4 no RJ45 data points

6. Floor boxes will be served via buried screed trunking

   a) Provision to be included trunking drops from high level to the ground.

   b) Location of drops to be coordinated with the Architect

7. Rooms not provided with floor channels shall be provided with perimeter dado trunking.

8. Point of use domestic hot and cold water, sanitary ware, waste, drainage water supplies to all WCs.

9. Provision of disabled toilet alarms for disabled toilets.

10. Point of use domestic hot and cold water for the shower areas.

11. Provision of services (power, lighting, water services, point of use water heaters, drainage) to kitchenette as indicated on the drawings.

12. Provision of power and audio / visual facilities to all meeting rooms as indicated on the drawing.

13. All other non-office rooms, to be provided with services as indicated on the drawings.

14. All tenant area fitout requirements are to be agreed in line with their requirements. Current provision on the drawing is indicative only and is to be finalised with the tenant prior to installation commencing.

21.0 ACOUSTICS

00 The planned activity is subject to the Environmental Acoustic Impact Assessment, in accordance with national and regional environmental acoustics regulations.

01 The technical standards currently in force and used for the execution of the acoustic assessment are indicated below.

National standards

- Legge Quadro 447 of 26 October 1995
- D.P.C.M. of 14 November 1997
- Decreto Ministero dell'Ambiente of 16 March 1998
- Decreti Legislativi n. 41-42 del 17 Febbraio 2017

Regional regulatory framework

- Lombardy Region Law No 13 of 10 August 2001
- D.G.R Lombardia no. VII/8313 of 8 March 2002
- D.G.R Lombardia n. X/1217 of 10 January 2014

Municipal regulatory framework

- Acoustic Classification Plan of the Municipality of Siziano

02 This assessment only concerns the acoustic impact of the activity in question pursuant to the mentioned legislation, therefore other types of assessment are excluded (e.g. assessment pursuant to Legislative Decree 81/08, assessment pursuant to Art. 844 of the Civil Code, etc., assessment pursuant to the Presidential Decree of 5 December 1997).

03 The evaluation was carried out through the following phases:

A. Initially, a reconnaissance of the area and the places was carried out, requesting from the Client all the information useful to characterize the activity in question temporally and acoustically. All the information relating to the systems that will be installed (type, location, operating hours) has been obtained.

B. The documentation constituting the Acoustic Classification Plan of the Municipality involved was acquired in order to identify the acoustic areas to which the planned activity and the receivers belong.

C. Potentially disturbed sensitive receivers were identified and phonometric measurements were carried out in order to determine the background noise in the area, only during the day (06:00 - 22:00) because the receivers are characterised by the presence of people only at that period.

D. On the bases of the measured noise values and the information received about the new sound sources introduced by the project, forecast simulations were carried out using a specialist acoustic software and the results were compared with the limit values imposed by legislation.

04 The calculations were carried out under precautionary conditions.

05 For further information on the acoustic specifications and on the results of the regulatory checks, please refer to the report MIL08A-L22-XX-XX-CA-ACO-00001.

21.2 External Noise Limits from Plant

21.2.1 The noise emitted from the development shall meet the noise limits imposed within the ~~SCIA~~ Noise Impact Assessment Report by Lombardini22 and Atmos Building Physics.

01 The performance requirements are taken from the Noise Impact Assessment Report which provides the overall acoustic requirements for the project. The individual plant noise limits are based on the noise limits within the report and require the mitigation measures included in the report.

02 The Contractor shall provide full technical sheets with noise data in frequency for each machine/equipment to validate that all final selected equipment & plant meets the acoustic requirements as detailed within the forementioned Noise Impact Assessment Report.

21.3 Chillers

01 The A weighted sound power levels of each chiller shall not exceed 94 dBA LwA during daytime and 91 dBA LwA during night period

02 Factory testing of the noise levels of the units shall follow the methodology of ISO 3740 series or ISO 9614 and the test methodology shall be agreed and witnessed by the Client's acoustic consultant.

21.4 Generators

01 Each containerised generator set shall include noise control treatments for the air inlet, air discharge and engine exhaust.

02 The acoustic data of generators, the characteristics of the engine sound insulation box and the attenuation data of the exhaust silencer must be submitted to the customer's acoustical consultant for approval.

03 The frequency sound power levels for each face and for the exhaust must be provided by manufcturers.

21.5 Air Handling Units

01 All AHUs must be equipped with silencers at least 1.5 metres long on all 4 ducts: air intake, expulsion, supply air, return air.

02 The frequency sound power levels of air intake, expulsion, supply air, return air and irradiated noise must be provided by manufcturers.

22.0 PLANT REPLACEMENT STRATEGY

22.1 Overview

01 The Contractor shall provide a complete plan for the replacement of all plant equipment identified in the project scope, ensuring that the design accommodates long-term operational efficiency and minimises downtime.

02 The Contractor shall evaluate and propose suitable plant replacement options, including but not limited to MV/LV switchgear, transformers, generators, cooling systems, and critical systems.

03 The Contractor shall check and update the plant replacement drawings based on actual site conditions and final equipment selection. The current plant replacement drawings are provided to detail the design intent.

04 The Contractor shall develop the design intent in line with the final plant selection and detailed design of the building and installed services. The Contractor shall submit a design that integrates seamlessly with the MEP systems, ensuring minimal operational disruption.

05 The complete plant replacement strategy documents to be developed by the Contractor in next stage in line with the design development and final installation, equipment selections and manufacturers recommendations and ensure it does not disrupt the critical infrastructure or operations of the data centre during the construction phase.

06 The Contractor shall provide detailed design drawings, specifications, and technical data sheets for each piece of equipment proposed for replacement, including their physical dimensions, capacities, weights, and integration points with existing systems where applicable.

07 The Contractor shall design the replacement plant with consideration for future expansion or upgrades, including space allocation, and integration paths for future plant or system enhancements.

08 The Contractor shall develop the plant replacement plan in line with the most up-to-date industry standards and regulations, ensuring compliance with local regulations, including CEI, IEC, and ISO standards where applicable.

09 Operation and maintenance manual to be handed over at the completion of the installation works by the contractor. The Contractor shall also ensure that the Manufacturers contact details and technical details of the plant and equipment are provided in the O&M manuals.

10 The O&M manuals to include instructions on how to maintain individual items of plant, fault diagnosis, maintenance schedules (i.e. nature and frequency of inspections, examinations, tests and maintenance), and major overhaul procedures.

11 Consideration shall be given to the access, maintenance and replacement strategy for mechanical and electrical plant throughout the project. In developing the strategy, the following to be considered as a minimum:

1. Safe access for maintenance and replacement of plant and all levels.
2. Permanent access to plant areas via stairs and fixed ladders wherever practicable.
3. Access for maintenance via permanent gantry, cradles or mobile plant.
4. Sufficient access for mobile equipment to pass through doors, corridors and lifts for maintenance and replacement.
5. All access areas support the weight replacement plant, moving equipment and any temporary plant.
6. Provision of permanent barriers or parapet protection and signage to edges, gaps and holes and other fragile areas.
7. Provision of defined anti-slip roof ladders, walkways and or platforms.
8. Provision of power and lighting.
9. Provision of sufficient space around individual items of plant and equipment for maintenance.

12 The Contractor shall provide a maintenance plan for the replacement plant, including recommended inspection intervals, servicing requirements, and spare parts, reducing the risk of future failures.

13 The Contractor shall coordinate plant replacement works with other project teams, including electrical contractors, mechanical contractors, and IT vendors, to ensure that all systems work together as a unified infrastructure.

14 The Contractor shall ensure that coordination between plant replacement and other ongoing construction works is seamless, particularly for works affecting critical systems and infrastructure.

15 The strategy to include a schedule of MEP equipment's location, size, weight, method of removal required.

16 The Contractor shall determine and provide RAMS for all removal/replacement works which shall include but not limited to isolation strategies and methods of maintaining resilience. The Contractor will need to provide a method statement as part of the tender for the installation strategy.

17 The Contractor shall assess and document all potential risks associated with the replacement of plant, including risks to existing infrastructure, operational continuity, and safety.

18 The Contractor shall develop and implement a risk mitigation strategy for plant replacement, identifying measures to minimise the impact of equipment downtime, integration issues, and unforeseen operational challenges during installation and commissioning.

19 Following procurement of final plant and equipment, the Contractor shall create a plant replacement report to align with the final equipment sizes. The final document shall be available eight (8) weeks prior to practical completion.

22.2 Large Items

01 Major/large items of MEP equipment's which provide the main cooling and power infrastructure to the building are generally located within the external equipment yard and roof gantry areas.

02 Major items include generators, electrical power modules, Chillers, Buffer Vessels, AHU's and VRF outdoor units. The plant replacement developed by the contractor shall include plant removal strategy for the same where a crane lift might be necessary.

03 The contractor shall ensure that the appropriate RAMS and crane lifting plan is in place and approved by the client operations team prior to any lifting operations being carried out. The Contractor shall validate the structural load bearing capacity of the adjacent road/carriageways.

04 The plant replacement must refer to the procured plant specific weight data to finalise the lifting plan and strategy. If this is not clear, the manufacturer should be contacted for further guidance and ensure that the correct lifting data is referred to and prescribed manufactures procedures are adhered to.

05 Crane outriggers shall be positioned on spreader matts on the road, kerb and grass areas to ensure there is no minimal damage to surrounding areas.

06 If major plant sub-components can be replaced instead of the entire item of plant, it is envisaged that these shall be replaced using manual handling/trolley/pallet trucks to the loading bay. This must be assessed on a case-by-case basis after considering manufacturers O&M manuals and data.

07 Items that are constructed in a modular basis shall also be stripped down to their individual component parts or modules for maintenance and replacement.

08 AHU's and condenser units can be craned straight off and onto a waiting truck from the roadway. Smaller items such as the compressors and various smaller condenser units shall be disassembled and transported to the goods lift and to the loading bay in the ground floor level.

09 External plant such as the electrical container rooms and mechanical plant rooms, can be taken out either in sections or whole via the roadway.

10 Where equipment cannot be landed directly into position by the mobile crane, the steel gantry shall be temporarily decked out with suitably sized flat steel plate to facilitate movement of equipment over the open mesh gantry. The equipment shall then be rolled into its final resting place.

22.3 Small to Medium Items

01 The plant replacement developed by the contractor shall include plant removal strategy for smaller items such as VRF indoor units, domestic pumps, Valves, filters, CDU's, FWU's, degassers, PV's and racks. As well as component replacement for larger plant when manual handling and routing via goods lift to the loading bay is required.

02 Most of the internal equipment shall be taken out via internal corridors to the loading bay. All doors shall have a minimum height of 2.8m.

03 The rack path shall be maintained clear from equipment/hangers/sprinkler heads. Clear height of 3.1 meters in the corridors and a clear height of 3.8 meters inside the data halls.

04 The lifting strategy shall be developed by the Contractor to take into account all of the risks of working in the proposed location, with approved mitigation.

05 The plant replacement Contractor shall review the O&M manuals when planning any exercise that includes removal or replacement of major plant or components.

06 For any component located at high level, it is proposed that a push around vertical or cherry picker is used instead. The push around vertical can provide a higher reach than a normal ladder, as well as providing an enclosed platform which ensures safe working conditions.

07 Lifting platform shall be used to access high level plant/equipment internally to the building, including the data hall. The data halls will require high level access, such as changing of light fittings, sprinkler head maintenance, and a vertical lift would be used due to its high reach as well as compact size

08 Where maintenance, removal or replacement activities for individual components require the manoeuvring of small items of plant and these exceed the weight limit that can be manually handled (in accordance with the latest Manual Handling Guide and Ergonomic Assessment Tools), it is proposed that a pallet truck or other suitable lifting equipment is used. This shall be provided by a specialist maintenance company and be used to transport the item/s to the loading bay for removal from the site.

09 All activities involving manual handling are to be covered by RAMS and are to be reviewed and agreed by the Client prior to works commencing. Where the plant replacement contractor proposes to use the special equipment as part of the plant removal strategy, this must be approved with the Client prior to removing any plant and adequate means of protection should be installed in advance of any works.

22.4 Special Considerations

01 Special considerations shall be given to specific items of plant where the normal replacement strategies cannot be followed or where special arrangements may need to be put into place.

02 The fan wall units generally come in two sections, a top and bottom section. For plant repair/replacement, the unit will need to be further broken down into individual components, such as filter, coil, fan sections. The fan wall unit replacement must be carried out within the mechanical gallery itself.

23.0 CFD STUDY

01 An initial preliminary external & internal CFD study relating to the heat rejection and cooling equipment has been undertaken. However, any adjustment shall need to be incorporated in the Contractor CFD studies.

02 It shall be noted that it is a requirement for the Contractor to develop any detailed CFD studies required for demonstrating compliance to customer requirements. CFD study/analysis shall include but not limited to external equipment, internal critical spaces, MMR & POE room, transformer, and generators, buffer vessel transient chilled water simulations.

03 The detailed external CFD study for the roof gantry shall be based on the design development and final selected equipment manufacturers for heat rejection and cooling equipment e.g. air-cooled chillers, air handling equipment, VRF outdoor units, and any MEP equipment on the roof.

04 The detailed external CFD study shall also take into consideration the impact of the ground floor containerised generators and their associated chimneys.

05 CFD studies of external roof gantry and final day arrangement shall consider wind conditions with all plant and equipment (generators, chillers, air handling units, VRF outdoor units etc) operating at 100% duty as well as any barriers. CFD studies shall be carried out for MIL08A and MIL08B buildings combined.

06 CFD study of typical $6MW_{IT}$ Data Hall, and $4MW_{IT}$ DH for normal operations and failure operations under various scenarios to be agreed with the Client and his technical representative. Transient study of the rate of rise in the Data Halls during changeover between utility and generator power. This study may need to cover with 1-D flow network consideration to accurately predict the temperature in DH during transient conditions.

07 The CFD study shall also take into consideration the exact services configuration within the space including the deployment of hot aisle containment.

08 In addition to the above, the contractor shall ensure that the cooling infrastructure, generator synchronisation time and subsequent transformer energisation is appropriate to limit the temperature to no more than 35°C at any server inlet, in any situation, including the below scenarios:

1. Loss of utility supply and transfer to generator.
2. Transfer to utility from generator.

09 The results of the CFD shall assess the worst-case conditions and shall be used as the basis of plant selections.

10 The plant selections will be appropriate to provide the required duty at full building load, with respect to the worst-case results from the CFD and peak environmental conditions.

11 The Contractor shall also include for normal operation and various failure scenarios of each item of critical plant; but, in any event, the failure scenarios shall be undertaken for the varying wind conditions.

12 The Contractor shall also include for normal operation and various failure scenarios of each item of critical plant.

13 Each of the Contractor's CFD studies shall account for the following conditions:

1. N units operational.
2. N+2 units operational.
3. Extreme ambient temperature.
4. With and without the worst-case winds (for external CFD).
5. 100% IT load.
6. Stage 4 Scenarios as below minimum; (Emergency mode)
   a) No wind Condition.
   b) Prevailing Wind with N = 20 with average wind velocity.
   c) Prevailing Wind Direction with N = 20 with average highest wind velocity.
   d) 2nd Prevailing Wind Direction with N = 20 with average wind velocity.
   e) Site based worst Wind Direction with N = 20 with average wind velocity.

14 The Contractor shall agree all CFD study parameters prior to undertaking the study with the Client's representative.

15 All physical air barriers, such as walls, parapets, screening or any element that restricts airflow should be considered.

16 Internal transient data hall study should be run with worst of loading in the data hall arrangement.

17 Critical rooms should be considered for the normal and failure conditions. If the cooling units are not backed by UPS, then it should also be considered for the transient conditions.

24.0 BUILDING AUTOMATION & CONTROLS SYSTEM(BACS)

01 The BACS is an overarching information gathering, monitoring, and display information obtained from other monitoring systems.

02 The design objective of BACS is to ensure continuity of service, to increase overall efficiency, and to meet immediate capacity needs of the data center. The BACS tools assist data center personnel in gaining a detailed view of the data center environment, making informed decisions for effective planning and management of data center assets, planning and forecasting future data center capacities, monitoring energy consumption, controlling environmental costs, and ensuring the overall health of the data centres and its assets.

03 The system shall directly control HVAC and other plant equipment as specified in BACS Specifications & Point list.

04 All Chiller control shall be done through PLC based controllers only.

05 Integrated building Control automation system (BACS) and backbone communications network for monitoring and control of critical systems (see BAS specifications for scope);

06 Control and monitoring system for the data centre comprises of three independent systems

1. CMS (Cooling management System),
2. BMS (Building Management System) and
3. EPMS (Electrical Power Monitoring System).

07 The CMS controls and monitors all the functions and parameters related to the production and distribution of the medium temperature chilled water system feeding the critical HVAC components which maintain the temperature of the data halls and critical rooms.

08 Each mechanical chiller string will have its own dedicated I/O module which will monitor and control the function of that equipment locally based on the command/parameters received from the Plant Managers (PLC Panel).

09 The PLC and its modules for the CMS are provided with UPS powered redundant power source to allow uninterrupted system operation.

10 The PLC and its modules for the CMS relate to redundant communication paths to allow uninterrupted communication in case of any line breaks.

11 The BMS will be monitoring and controlling all the functions and parameters related to non-critical HVAC equipment's of the data centre. This includes, domestic water system, exhaust fans, public area air conditioning, interfaces with other services like security and fire alarm system.

12 The BMS will comprise of standard commercial Direct Digital Controllers (DDC).

13 The EPMS have distributed control philosophy and will connect to the central communications backbone cabling system to allow intercommunication between outstations around the Data centre. DDC shall be provided in each LV room connecting to the Electrical infrastructure.

14 The EPMS DDC contains Input controllers & Gateways facilitating the connection based on best industry practise.

15 EPMS DDC will be connected back to the MMR room on ring topology benefit is that if a cable or Access switch fails, just one node is going to be communicating to the server maintains resiliency in the network.

16 The system architecture shall be comprised of BMS, EPMS servers; custom programmed controllers, networks and integration of packaged equipment. Provide and field install controllers and equipment for a complete control and monitoring system. Controllers a shall interface to the BMS servers by means of TCP/IP Ethernet communications which will also be used for peer-to-peer communications.

17 Configure the system such that a loss of a central controller will not affect the operation and control of a unit controller or packaged equipment. In addition, the loss of a unit controller will not affect the operation of other controllers. Monitor communications to the BMS and between controllers using a failsafe method and alarm a loss of communications event.

18 Develop the communications network architecture and overall system performance to have a maximum latency of 8 seconds or less from a state or value change at the controller to where the change is reflected on the BACS graphic screen.

19 The BACS system architecture shall not allow for a single point of failure.

20 The system shall consist of a distributed system of fully intelligent controllers, operating in a multitasking, multi-user environment on a TCP/IP Ethernet network for supervisory and peer-to-peer communications.

21 Provide controllers that can operate in a stand-alone mode on loss of a communications. Provide central controllers for area monitoring and space setpoint reset control.

22 Provide managed Ethernet switches for BMS communications. Hubs will not be allowed.Coordinate with GC, STACK IT on quantity, Model and acceptable locations of switches required.

23 Each controller shall have a USB or RJ-45 Ethernet communication port for temporary connection to a laptop computer or other operator interface. Connection shall support memory downloads and other commissioning and troubleshooting operations. Controller information such as data, status, and control algorithms shall be viewable and editable from at controller.

24 MQTT Interface shall provide for Tenant accessing the BACS .

24.1 Sensor arrangement in Critical Spaces.

01 Cold Aisle is provided with 3 Nos Temp/humidity sensors communicating on Modbus RTU and connected to DDC. Alternate sensors in each cold aisle is connected to different gateway so that monitoring of entire cold aisle is not lost in case of communication or gateway failure.

02 Each data hall is provided with 4 Nos data hall temp/humidity sensors located in 4 corners of the data hall.

03 Differential pressure sensor is installed between each cold to hot aisle to understand the airflow patterns and monitor their efficiency throughout. The pressure difference between the two would indicate proper airflow from cold to hot.

04 Two differential pressure sensors are installed for each data hall space to monitors the differential pressure between whitespace and an adjacent corridor.

05 Temperature/Humidity Sensors shall be provided for LV module.

24.1.1 BACS Server Software

01 The BMS Server software shall be designed on a MICROSOFT WINDOWS-based platform and have on-line full-screen editing to facilitate the programming and monitoring of the system. The Server and remote Client locations will allow the monitoring of vital system parameters and provide a scalable system for future expansions without replacement of the hardware or software.

02 Shall show parameters on screen which are available from the individual remote controllers both DDC and PLC, including but not limited to equipment status, alarm status, device position and/or status, modes of operation, setpoints, commands, events, etc.

03 Shall provide a memory map of PLC and DDC system points and software access to the BACS alarms, equipment status and the ability to link to BMS screens.

04 Shall provide diagnostics information on device or system malfunctions, such as devices not communicating, watchdog alarms, stale data indication, etc.

05 Shall support unlimited number of individual computer alarm levels for monitored parameters,such as setting low and high alarm levels for voltage, current, motor run time,etc. These alarm levels shall be independent of device built-in alarm levels. Support signed alarm setting values (+/-) as well as high and low limits.

06 Shall support setting multiple limits, providing additional alarm points above or below the initial limit.

07 Shall provide a fully customizable alarm/event log where unlimited log views can be created by the user in real-time for organizing, filtering and prioritizing different alarms (i.e. Minor Alarms, Critical Alarms, General Alarms, etc.).

08 Shall provide the following software packages to allow for maximum flexibility and expandability.Support unlimited remote Clients and the following device point level packages:

1. Unlimited monitoring points – Server and Client.
2. Unlimited monitoring points – Full Client.

09 Shall support performing mathematical and logical operations for control, viewing, logging of alarming of monitored data.

10 Shall display in a real-time trending mode a graphical representation of either monitored or calculated data.

11 Shall support on-line programming and configuration modifications such that it is not necessary to shut down any part of the system during programming operations.

12 Alarm and Data Log Information: The Owner shall be able to access the database of alarm/events and electrical data in a query format. This query shall be programmable and set to an icon or button for repeatability (i.e. last 7 days loading, critical alarms, UPS alarms, etc.).These icons shall be able to be placed in any graphic screen or table. Unlimited queries shall be possible. The query shall allow the Owner to mix, sort, filter and trend the alarm/events and electrical data in any way the Owner desires (by date, by device, by priority, etc.) in order to provide the Owner with a limited data set to review and analyze. It will be possible for the Owner to request a list/table of just the events desired for a particular device, group of devicesor particular events (all sags, trip events, etc.) by clicking on an icon on the screen. A “one button = whole alarm list” for devices and alarms is not acceptable.

24.1.2 BACS Server Hardware & Operating System

01 Provide BMS,EPMS server hardware and operating system software. BMS Contractor is responsible for server configuration and required applications. Communications and application software shall comply with the following minimum requirements:

02 Server application operating system must be compliant with the BMS server software requirement.

03 Client application operating system must be compliant with the BMS Client software requirements.

04 Non-Microsoft operating systems (Linux, Unix, and free BSD) or applications are not allowed without STACK IT approval.

05 Server application operating system must be compliant with the BMS server.

06 Server and data storage equipment shall be redundant.

24.1.3 Controller Software

01 Building management application software shall reside and operate in system controllers. Applications shall be editable through operator workstation, or engineering workstation.

02 Remote Communication: System shall automatically contact operator workstation or server on receipt of critical alarms.

03 Sequencing: Application software shall sequence HVAC equipment as specified in Sequence of Operations.

04 PID Control: Provide PID (proportional-integral-derivative) algorithm with direct or reverse action and anti-windup. The algorithm shall calculate a time-varying analog value that is used to position an output or stage a series of outputs. The controlled variable, set point, and PID gains shall be user selectable.

24.1.4 BMS/EPMS Controller

01 Provide Central Building Controllers, Unit Controllers, and Application Specific Controllers for commercial and terminal units, Smart Actuators and Smart Sensors as required to achieve the specified System Performance.

02 Primary BMS controller communication shall be BACnet/IP and Modbus functional.

03 Service Port: Each controller shall provide a service communication port for connection to a Portable Operator's Terminal.

04 Signal Management: Controller operating systems shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and to allow for central monitoring and alarms.

05 Data Sharing: Each Central and Unit Controller shall share data over the network as required to achieve the control described in the SOOs.

06 Controller hardware shall be suitable for anticipated ambient conditions.

07 Controllers used outdoors or in wet ambient conditions shall be mounted in IP 65 (NEMA 4) waterproof enclosures and shall be rated for operation at minus 29 degrees C to plus 60 degrees C.

08 Controllers shall have diagnostic LEDs for power, communication, and processor status.

09 Each Controller shall continually check its processor and memory circuit status and shall generate an alarm on abnormal operation. System shall continuously check controller network and generate alarm for each controller that fails to respond.

10 Each Controller shall use non-volatile memory and shall retain BIOS and application programming in the event of power loss. System shall automatically download dynamic control parameters following power loss.

11 Controllers shall be able to operate at 90 percent to 110 percent of nominal voltage rating and shall perform an orderly shutdown below 80 percent nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m.

12 Protection: Shorting an input or output point to itself, to another point, or to ground shall cause no controller damage. Input or output point contact with up to 24V for any duration shall cause no controller damage.

13 Binary Inputs: Binary inputs shall monitor the on and off signal from a remote device. Binary inputs shall provide a wetting current of at least 12 mA and shall be protected against contact bounce and noise. Binary inputs shall sense dry contact closure without application of power external to the controller.

14 Analog Inputs: Analog inputs shall monitor current (0-20 mA and/or 4-20 mA) signals. On approval from Owner low-voltage (0-10V dc) or resistance (RTD) signals can be used for limited distances.

15 Binary Outputs: Binary outputs shall send an on-or-off signal for on and off control. Outputs shall be selectable for normally open or normally closed operation. Output modules shall support both dry contact type to switch externally powered circuits and source 24V dc or 24 VAC outputs powered from the controller panel.

16 Analog Outputs: Analog outputs shall send a modulating current (0-20 mA or 4-20 mA) signal as required to properly control output devices. On approval from Owner low-voltage (0-10V dc) output signals can be used for limited distances. Each Building Controller analog output shall have a two-position (auto-manual) switch, a manually adjustable potentiometer, and status lights. Analog outputs shall not drift more than 0.4% of range annually.

24.1.5 BMS Standard Graphics Display

01 Graphic displays shall be made available on the BMS workstations.

02 Operator Functions: Operator interface shall allow each authorized operator to execute the following functions as a minimum:

03 Log In and Log Out. System shall require username and password authentication using active directory / LDAP user accounts and groups.

04 Point-and-click Navigation: Operator interface shall be graphically based and shall allow operators to access graphics for equipment and geographic areas using point-and-click navigation.

05 View and Adjust Properties: Operators shall be able to view controlled equipment status and to adjust operating parameters such as setpoints, PID gains, on and off controls, and sensor calibration.

06 View and Respond to Alarms: Operators shall be able to view a list of current active system alarms, to acknowledge each alarm, and to clear (delete) unneeded alarms.

07 View and Configure Trends: Operators shall be able to view a trend graph of each trended point and to edit graph configuration to display a specific time period or data range. Operator shall be able to create custom trend graphs to display on the same page data from multiple trended points.

08 View and Configure Reports: Operators shall be able to run preconfigured reports, to view report results, and to customize report configuration to show data of interest.

09 Manage Control System Hardware: Operators shall be able to view controller status, to restart (reboot) each controller, and to download new control software to each controller.

10 Manage Operator Access: Typically, only a few operators are authorized to manage operator access and group roles: Authorized operators shall be able to view a list of operators with system access and assign roles they can perform while logged in. These authorized Operators shall be able to add operators, delete operators and to edit group roles.

24.1.6 Cooling management System

01 Redundant PLC based system shall be used for the chilled water system management and control.

02 PLC/ Remote IO Module shall be based on modularity, ruggedness, capability for easy expansion and future hardware and software upgrades, distributed structure, extensive communication capabilities, and user-friendly programming software. It shall comply with IEC 61131.

03 Support of multiple programming languages. IEC 61131-3 Compliant.

04 PLC/Remote IO Module Fault tolerant qualifications for Power Supplies, CPUs and communications network redundancy capabilities.

05 The PLC/Remote IO panel racks must be capable of containing minimum Two communication modules to provide communication interfaces to third-party devices.

06 PLC/ Remote IO Module t be capable of establishing communications and exchange data, via the adequate modules installed on PLC/DDC backplane, with third party equipment. Communication protocols include, but not limited to, BACNET/IP, Modbus, TCP/IP Ethernet Interface, RTU protocol, ASCII, PROFIBUS a

07 Reference shall be made to the separate Building Management Systems Project Specification document.

25.0 LEAK DETECTION

25.1 Requirement

01 Installation of a liquid leak detection system shall provide continuous protection from the risk of water and other liquids leaking within critical areas of the building. This includes Data Hall Hot Asile Containment, Data hall Perimeter, Perimeter of MEP Gallery, POE, MMR, Electrical rooms, Electrical Power modules.

02 Leak detection system shall be based on a digital monitoring unit, addressable sense cables, jumper cables and all required auxiliary equipment. This system shall detect and locate multiple leaks simultaneously as well as cable break faults

03 The liquid leak detection system shall identify any abnormal presence of liquid on any point of its connected sense cables, to the nearest meter.

04 In the event of a leak, an audible alarm shall be triggered, and the dry contact shall be activated. The panel's screen display shows the time and date of the alarm, the type of fault and the location of the leak to the nearest metre. Dynamic zone maps highlighting faults on the panel's screen shall be available. A power failure relay shall be activated when the power shuts down.

05 The panel shall be able to show all the cables connected and group them by zone as required.

06 Every sense cable shall be able to detect and locate leaks independently. The system shall be able to show simultaneous faults.

07 Besides leaks, the system shall be capable of detecting any damaged sense cables (cable break). In the event of a cable break, an audible alarm shall be triggered, and the dry contact shall be activated. The dynamic zone maps showing a cable break and highlighting the exact location on the panel's screen shall be available.

08 The system shall be capable of monitoring minimum of 1500 metres of cable from a single monitoring unit. This length shall not include the jumper cable. The panel shall be able to show all the cables connected and group them by zone.

09 Every sense cable shall be able to detect and locate leaks independently. The system shall be able to show "n" number of simultaneous faults.

10 The system shall be capable of detecting conductive liquids such as water, bases and acid, or non-conductive liquids as hydrocarbon and solvents. The system shall be able to manage all types of sense cables mixed on the same panel.

11 Hydrocarbon Leak detection shall be provided for Fuel distribution and generator.

25.2 Sensing Cable

01 The system shall comprise pre-connected sensing cable and sensing cable components all with locking connectors.

02 The sense cable shall consist of a helically winded central core (data bus), on which PEHD (Polyethylene high-density) conductor wires are spiralled. This shall ensure a prompt detection as well as a short drying time after the risk is eliminated. The insulation and signal wires shall be made of flame-retardant polymer. The jacket of sense wires shall be made of conductive polymer on the ground wire. The active sense wire shall have a special dust-proof construction and shall not be affected if in contact with any metal parts like cable baskets, flooring or ground braids.

03 The sense cables shall be connected via male and female connectors. A microcontroller shall be embedded in the sense cable to ensure digital and independent leak detection and communication between each sense cable and the digital monitoring unit.

04 Each sense cable shall have its own identity or unique address. This shall be programmed directly by the installer or the user, using the touch screen on the front face of the monitoring unit

05 Its optional to have status of the sense cable shall be indicated by a LED embedded in the cable connector.

06 Accessories shall be pre-connected. Jumper cable as well as end termination plug shall ensure the continuity of each circuit.

07 The sensing cable shall be of such construction that no metallic parts are exposed in order to avoid corrosion.

25.3 Leak detection Panel

01 The digital monitoring unit shall be a microprocessor based complete leak locating system. It shall receive data processed and transmitted by each sense cable as well as raising the alarm. It shall be supplied from the same supplier as the sense cables.

02 The digital monitoring unit shall be supplied by 100 VAC to 240 VAC, 50-60Hz, single phase.

03 A screen display shall be assembled on the front of the digital monitoring unit. In the event of simultaneous leaks or multiple faults, the display shall show all alarms.

04 The Digital Monitoring unit shall be able to provide a general view of the installation on the screen. An interactive floor plan shall be available under this menu as an optional feature

25.4 Installation

01 The installation shall not take place until all construction work to the area of installation is completed, all debris and construction by products have been taken away and the area cleaned.

02 The sensing cable system and alarm module shall be of the type that is simple to install, commission and maintain without the need for special tools, e.g., oscilloscopes, sine wave generators, etc.

03 Sensing cable shall be removed should it be necessary to conduct any local building modifications and replaced when completed.

04 Upon completion of the installation the system shall be commissioned in strict accordance to the manufacturer's instructions.

26.0 TRACE HEATING

26.1 Requirement

01 The Contractor shall provide self-regulating frost protection trace heating to all external pipework. The Contractor shall approach a specialist sub-Contractor to develop the trace heating scheme from the principles set out below. The electrical Contractor shall provide the power supplies to the positions identified by the mechanical Contractor.

02 All electric trace heating cables shall be of the energy efficient self-regulating polymeric type whose power output decreases with increasing temperature, manufactured, installed and tested in accordance with all regulations and technical standards.

03 The self-regulating trace heating cables shall be capable of maintaining the defined power output for a period in excess of 25 years.

04 Ensure that the electric trace heating cable manufacturer has available a trained and competent field engineer for providing technical support and installation training or provide a list of approved field engineers.

26.2 Specialist Sub-Contractors

01 All electric trace heating systems shall be installed, tested and terminated strictly in accordance with the manufacturer's instructions.

02 Thermal insulation shall be applied to the pipework, flanges, unions, valves etc. without delay to avoid unnecessary risk of damage to the trace heating cables.

03 All electric wiring between the trace heating circuit terminal units, control sensors/systems (where required) and local distribution boards or motor control centres/control panels shall be carried out by others in accordance with the Project Documents. Each trace heating circuit shall be protected electrically by use of a type 3 or 4 circuit breaker in combination with residual current devices and sized in strict accordance with the heating cable manufacturers recommendations. These shall be incorporated in the local distribution board or motor control centre/control panel as specified elsewhere.

04 Each trace heating circuit shall have an automatic contactor with an SP&N isolator, HAND/OFF/AUTO selector switch and terminals for remote control, complete with a "MAINS ON" lamp and "HEATING CABLE OPERATING ON" lamp. These shall be incorporated in the local distribution board or motor control centre/control panel as specified elsewhere.

05 The electric trace heating system components for power connections, tee splices etc. shall. except in special circumstances, take the form of insulation displacement type with all other ends being terminated with silicone gel end seals to a minimum of IP65 for outdoor application and IP54 for indoor application.

26.3 Freeze Protection to Exposed Mechanical Services

01 The freeze protection electric trace heating cables shall be provided and fixed on all insulated external pipework above ground and insulated pipework in unheated areas to protect the pipe contents from freezing.

02 The electric self-regulating trace heating cables shall incorporate a modified polyolefin/fluoropolymer outer jacket, tinned copper braid and modified polyolefin over jacket.

03 Electric trace heating cables shall be fitted to the whole of the exposed insulated pipework and fittings including control valves, isolating and balancing valves, non-return valves, strainers, orifice plates, flanges, unions, etc.

04 All cold water supply services - maximum pipe contents temperature 10ºC.

05 Domestic hot water supply on a two pipe flow and return system - maximum pipe contents 60ºC.

06 All electric trace heating cables shall be adequately sized to compensate for the heat losses from insulated pipes to ensure that the exposed pipelines do not freeze during extended cold periods when the ambient air temperature is minus 17.1ºC.

07 Trace heating system is Contractor design portion (CPD), stage 4 documents show design intent only. System shall be design, installed, tested and commissioned by a specialist Contractor.

08 Trace heating systems' capacities considered at stage 4 is indicative/estimated only, Contractor shall verify system capacity as per final shop drawings and manufacturer recommendations.

09 Where traced heated pipework enters a building, housing, air handling unit, or other equipment, the heater shall extend a minimum of 500 mm inside.

10 All electric trace heating cables, weatherproof junction boxes, power connection and end seal kits, adhesive glass tape for metal pipes, aluminium tape for plastic pipes, "electric traced" labels, insulation entry kit, ambient and pipe sensing thermostats etc., shall all be as manufactured by Raychem Ltd or other equal and approved manufacturer.

11 All cold water and two-pipe domestic hot water services shall be freeze protected with Raychem Ltd., or equivalent, WinterGard FS-A-2X trace heating cable, having a power output of 10.9 watts/metre at 5°C, and installed to a maximum circuit length of 150 m.

12 Particular attention shall be given to providing extra trace heating cable length to overcome heat sinks such as valves, water meters, un-insulated pipe sleeves etc. All trace heating cables shall be terminated with insulation displacement connection components and gel seals with no heat shrinkable components in use.

13 All pipework with electrical trace heating shall be provided with suitable warning signs applied to the insulation at a spacing of not more than 3.0 m apart and on alternate sides of the pipe. The electric trace heating is to be sectionalised according to the maximum circuit lengths, each section/system being complete with the following: -

1. All necessary trace heating cables.
2. A weatherproof air sensing thermostat, except those circuits requiring pipe surface sensing weatherproof thermostat e.g. all cold water, chilled water services. The thermostat shall be set to bring on the heating when the air or pipe temperature drops below 4ºC.
3. Weatherproof system components with universal pipe bracket.
4. Insulation entry kits.
5. Fixing tape.
6. Warning labels.

14 Ensure that all trace heating is completely installed back to the junction boxes and tested prior to the application of the thermal insulation.

15 The equipment and installation shall be in accordance with all regulations and technical standards.

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27.0 LOCAL STANDARDS

01 In addition to those standards outlined within this and Black & White Engineering & L22 standard materials and workmanship specifications, and all local and national standards, the following standards shall be adhered to, throughout:

Systems	Standards
Technical reference rule for the connection of active and passive users to HV and MV networks of Utility companies	CEI 0-16
Electrical systems for users with a nominal voltage not exceeding 1000V in alternating current and at 1500V in direct current	CEI 64-8
Protection against lightning	IEC 62305
Low-voltage switchgear and controlgear assemblies	CEI EN IEC 61439
Power installations exceeding 1 kV AC and 1,5 kV DC	CEI EN IEC 61936
Earthing of power installations exceeding 1 kV a.c.	CEI EN 50522
Sound systems for emergency purposes	CEI EN 50849
Fire detection and fire alarm systems	UNI EN 54
Lighting applications - Emergency lighting	UNI EN 1838
Automatic fire detection and fire alarm systems - Design, installation and operation	UNI 9795
Light and lighting - outdoor lighting application	UNI 10819
Light and lighting - Safety lighting installations in buildings	UNI CEI 11222
Initial verification and maintenance of automatic fire detection and fire alarm systems	UNI 11224
Road lighting - Selection of lighting classes	UNI 11248
Light and lighting - Lighting of work places	UNI EN 12464
Road lighting	UNI EN 13201
Energy performance of buildings	UNI EN 15232
Fire detection and alarm systems - Part 19: Design, installation, commissioning and service of sound systems for emergency purposes	UNI ISO 7240-19
Information technology — Generic cabling for customer premises	ISO/IEC 11801
Tecnologia dell'informazione - Servizi ed infrastrutture dei data center	CEI EN 50600

27.1 For general design criteria:

01 Legge 1° marzo 1968 n.186 - Disposizioni concernenti la produzione di materiali, apparecchiature, macchinari, installazioni e impianti elettrici ed elettronici

02 D.M. 37/2008 - Regolamento concernente l'attuazione dell'art. 11-quaterdecies, comma 13, lettera a) della legge n° 248 del 2 dicembre 2005, recante riordino delle disposizioni in materia di attività di installazione degli impianti all'interno degli edifici

03 D.lgs. 81/2008 - Attuazione dell'articolo 1 della legge 3 agosto 2007, n. 123, in materia di tutela della salute e della sicurezza nei luoghi di lavoro"

04 D.lgs. 106/2009 - Disposizioni integrative e correttive del decreto legislativo 9 aprile 2008, n. 81, in materia di tutela della salute e della sicurezza nei luoghi di lavoro

05 D.lgs. 27 gennaio 2010, n. 17 - Attuazione della direttiva 2006/42/CE, relativa alle macchine e che modifica la direttiva 95/16/CE relativa agli ascensori.

06 For the general characteristics of the system:

07 D.lgs. 6 settembre 2005, n. 206 - Codice del consumo, a norma dell'articolo 7 della legge 29 luglio 2003, n. 229 (ex D.P.R. 224/88);

08 Direttive CEE 89/392, 91/368, 93/44, 93/68, 2006/42 meglio conosciute come "Direttive macchine" concernenti il ravvicinamento delle legislazioni degli stati membri relative alle macchine;

09 D.lgs. 27 gennaio 2010, n. 17 - Attuazione della direttiva 2006/42/CE, relativa alle macchine e che modifica la direttiva 95/16/CE relativa agli ascensori.

10 D.P.R. n. 392 del 18.04.1994 - Regolamento recante disciplina del procedimento di riconoscimento delle imprese ai fini dell'installazione, ampliamento e trasformazione degli impianti nel rispetto delle norme di sicurezza;

11 Legge 13/7/1966 n.615 – Provvedimenti contro l'inquinamento atmosferico;

12 DPR 22/12/1970 n.1391 – Regolamento per l'esecuzione della legge 13/7/1966 n.615 recante provvedimenti contro l'inquinamento atmosferico in particolare al settore degli impianti termici;

13 DM 1/12/1975 – Norme di sicurezza per apparecchi contenenti liquidi caldi sotto pressione;

14 DM 27/9/1965 – Determinazione delle attività soggette alle visite di prevenzione incendi;

15 DM 16/2/1982 – Modificazioni al DM 27/9/1965;

16 Circolare del Ministero dell'Interno, Direzione Generale Protezione civile e dei Servizi Antincendio 25/11/1969 n.68 – Norme di sicurezza per impianti termici a gas di rete;

17 DL 6/12/1971 n.1083 – Norme per la sicurezza dell'impiego del gas combustibile e relativi decreti di approvazione;

18 L. 9 gennaio 1991 n. 10 (con decreti e norme collegate) - Norme per l'attuazione del Piano energetico nazionale in materia di uso razionale dell'energia, di risparmio energetico e di sviluppo delle fonti rinnovabili di energia;

19 D.lgs. 19 agosto 2005 n. 192 – Attuazione della direttiva 2002/91/CE relative al rendimento energetico nell'edilizia;

20 D.lgs. 29 dicembre 2006 n. 311 – Disposizioni correttive ed integrative al D.lgs. 19 agosto 2005 n. 192, recante attuazione della direttiva 2002/91/CE, relativa al rendimento energetico nell'edilizia;

21 D.P.R. 2 aprile 2009 n.59 – Regolamento di attuazione dell'articolo 4, comma 1, lettera a) e b) del decreto legislativo 19 agosto 2005, n.192, concernente attuazione della direttiva 2002/91/CE sul rendimento energetico in edilizia;

22 D.M. 26 GENNAIO 2010 – Aggiornamento del decreto 11 marzo 2008 in materia di riqualificazione energetica degli edifici;

23 D.LGS. 3 marzo 2011 n.28 – Attuazione della direttiva 2009/28/CE sulla promozione dell'uso dell'energia da fonti rinnovabili, recante modifica e successiva abrogazione delle direttive 2001/77/CE e 2003/30/CE;

24 Decreto interministeriale 26 giugno 2015 - Adeguamento linee guida nazionali per la certificazione energetica degli edifici;

25 D.P.R. n. 412 del 26.08.1993 - Regolamento recante norme per la progettazione, l'installazione, l'esercizio e la manutenzione degli impianti termici degli edifici ai fini del contenimento dei consumi di energia, in attuazione dell'art. 4 comma 4, della Legge 09.01.1991, n. 10 e s.m.i.;

26 Decreti regionali Lombardia su efficienza energetica (DGR VIII/8745 del 22 dicembre 2008, DGR 5796 del 11 giugno 2009, DGR 3868 del 17 luglio 2015, DGR 6480 del 30 luglio 2015, Decreto n.2456 del 8 marzo 2017 e s.m.i.);

27 D.P.C.M. 1 marzo 1991 - Limiti massimi di esposizione al rumore negli ambienti abitativi e nell'ambiente esterno e s.m.i.;

28 D.P.C.M. 14/11/1997 – Determinazione dei valori limite delle sorgenti sonore;

29 L. 28 dicembre 1993 n. 549 - Misure a tutela dell'ozono stratosferico e dell'ambiente e s.m.i.;

30 DM 24 novembre 1984 - Norme di sicurezza antincendio per il trasporto, la distribuzione, l'accumulo e l'utilizzazione del gas naturale con densità non superiore a 0,8 e relativi regolamenti di esecuzione e circolari di istruzione;

31 D.M. 12 aprile 1996 - Approvazione della regola tecnica di prevenzione incendi per la progettazione, la costruzione e l'esercizio degli impianti termici alimentati da combustibili gassosi;

32 DM 20 Dicembre 2012 - Regola tecnica di prevenzione incendi per gli impianti di protezione attiva contro l'incendio installati nelle attività soggette ai controlli di prevenzione incendi;

33 Regio Decreto n. 1775 del 11/12/1933 - Approvazione del testo unico delle disposizioni di legge sulle acque e successive modifiche e integrazioni;

34 Legge n.896 /1986 - Disciplina della ricerca e della coltivazione delle risorse geotermiche e successive modifiche e integrazioni;

35 Decreto Legislativo n.152 del 03/04/2006 - Norme in materia ambientale e successive modifiche e integrazioni;

36 D.M. n. 443 21/12/1990 - Regolamento recante disposizioni tecniche concernenti apparecchiature per il trattamento domestico di acque potabili;

37 D.lgs. 02.02.2001, n. 31 Attuazione della direttiva 98/83/CE relativa alla qualità delle acque destinate al consumo umano.

38 D.M. 06.04.2004, n. 174 - Regolamento concernente i materiali e gli oggetti che possono essere utilizzati negli impianti fissi di captazione, trattamento, adduzione e distribuzione delle acque destinate al consumo umano;

39 D.M. 19/09/1959 - Attribuzione dei compiti e determinazione delle modalità e delle documentazioni relative all'esercizio delle verifiche ed ai controlli previsti dalle norme di prevenzione degli infortuni sul lavoro;

40 Circolare Ministero del Lavoro n. 800/I del 05/07/1960 prevenzione infortuni - verifiche e controlli.

41 Decreti regionali Lombardia relativi agli scarichi (Regolamento regionale 23 novembre 2017, n. 7; Regolamento regionale 29 marzo 2019 - n. 6; Regolamento regionale 19 aprile 2019 - n. 8 e s.m.i.)

42 Regolamenti e specifiche degli Enti gestori di servizi (Acquedotto, Aem, Enel, Telecom, etc.);

43 Regolamento d'igiene locale;

44 Regolamento edilizio locale;

45 Decreti regionali Lombardia;

46 Prevenzione infortuni (denunce e verifiche);

47 Norme U.N.I. (Unificazione Italiana) e CTI (Comitato Termotecnico Italiano)

48 Norme C.E.I. (Comitato Elettrotecnico Italiano)

49 Norme EN emanate dal CEN, Comitato Europeo di Normazione;

50 Norme emanate da ISO, International Standard Organization;

51 Norme e Standards emanate da EUROVENT, European Committee of Air Handling and Air Conditioning Equipment Manufacturers;

52 Norme e Standards emanate da ASHRAE, American Society of Heating Refrigerating and Air Conditioning Engineers (Atlanta, Georgia - USA);

53 Norme e raccomandazioni degli enti o società erogatori di servizi (acqua, gas, energia elettrica, comunicazioni, etc.);

54 Per le caratteristiche dei prodotti:

55 Tutti i componenti utilizzati dovranno essere nuovi di fabbrica, rispondere alle rispettive norme di prodotto, possedere marchio CE e dovranno essere conformi alle norme CEI in vigore od ad equivalenti europee.

56 Prescrizioni I.S.P.E.S.L. (ex Ente Nazionale Prevenzione Infortuni ed ex A.N.C.C.);

57 Prescrizioni e raccomandazioni del locale Comando dei Vigili del Fuoco e tutte le Norme e Leggi di Prevenzione Incendi;

58 Normative e raccomandazioni dell'A.S.L.;

59 Eventuali prescrizioni particolari emanate dalle Autorità locali;

60 Norme ed istruzioni dei fabbricanti dei componenti.

61 Other regulations, having the force of law, relating to individual components of the systems, even if not explicitly referenced, must be strictly applied.

27.1.1 Reference UNI standards for heating and air conditioning systems.

Standards	System
UNI EN 442-1 :2015	Radiatori e convettori. Parte 1: Specifiche tecniche e requisiti
UNI EN 442-2 :2015	Radiatori e convettori. Parte 2: Metodi di prova e valutazione
UNI EN 1264-1:2021	Sistemi radianti alimentati ad acqua per il riscaldamento e il raffrescamento integrati nelle strutture - Parte 1: Definizioni e simboli
UNI EN 1264-2 :2021	Sistemi radianti alimentati ad acqua per il riscaldamento e il raffrescamento integrati nelle strutture - Parte 2: Riscaldamento a pavimento: metodi per la determinazione della potenza termica mediante metodi di calcolo e prove
UNI EN 1264-3 :2021	Sistemi radianti alimentati ad acqua per il riscaldamento e il raffrescamento integrati nelle strutture - Parte 3: Dimensionamento
UNI EN 1264-5 :2021	Sistemi radianti alimentati ad acqua per il riscaldamento e il raffrescamento integrati nelle strutture - Parte 5: Determinazione della potenza termica di riscaldamento per pareti e soffitti e di raffrescamento per pavimenti, pareti e soffitti
UNI EN 1443 :2019	Camini. Requisiti generali.
UNI EN 1751 :2014	Ventilazione degli edifici - Dispositivi per la distribuzione dell'aria - Prove aerodinamiche delle serrande e delle valvole
UNI EN 1859 :2013	Camini - Camini metallici - Metodi di prova
UNI EN 1946-1 :2001	Prestazione termica di prodotti e componenti per edilizia. Criteri specifici per la valutazione dei laboratori che effettuano la misurazione delle proprietà di scambio termico. Criteri comuni.
UNI EN 1946-4 :2005	Prestazione termica di prodotti e componenti per edilizia. Criteri specifici per la valutazione dei laboratori di misurazione delle proprietà di trasmissione del calore. Parte 4: Misurazioni mediante metodi della doppia camera
UNI EN 1946-5 :2005	Prestazione termica di prodotti e componenti per edilizia. Criteri specifici per la valutazione dei laboratori di misurazione delle proprietà di trasmissione del calore. Parte 5: Misurazioni mediante metodi per prove a simmetria cilindrica.
UNI 5364 :1976	Impianto di riscaldamento ad acqua calda. Regole per la presentazione dell'offerta e per il collaudo
UNI EN ISO 6946 :2018	Componenti ed elementi per edilizia - Resistenza termica e trasmittanza termica - Metodo di calcolo
UNI 7129-(tutte):2015	Impianti a gas per uso domestico e similari alimentati da rete di distribuzione - Progettazione e installazione
UNI EN ISO 7730 :2006	Ergonomia degli ambienti termici - Determinazione analitica e interpretazione del benessere termico mediante il calcolo degli indici PMV e PPD e dei criteri di benessere termico locale

Standards	System
UNI EN ISO 7933 :2023	Ergonomia dell'ambiente termico. Determinazione analitica ed interpretazione dello stress termico da calore mediante il calcolo della sollecitazione termica prevedibile.
UNI 8199 :2016	Acustica in edilizia - Collaudo acustico di impianti a servizio di unità immobiliari - Linee guida contrattuali e modalità di misurazione all'interno degli ambienti serviti
UNI 8364-1 :2007	Impianti di riscaldamento. Controllo e manutenzione.
UNI 8364-2 :2007	Impianti di riscaldamento. Controllo e manutenzione.
UNI 8364-3 :2007	Impianti di riscaldamento. Controllo e manutenzione.
UNI EN ISO 8996 :2022	Ergonomia dell'ambiente termico. Determinazione del metabolismo energetico.
UNI 9165 :2020	Reti di distribuzione del gas - Condotte con pressione massima di esercizio minore o uguale a 5 bar - Progettazione, costruzione, collaudo, conduzione, manutenzione e risanamento
UNI EN ISO 9488 :2022	Energia solare. Vocabolario.
UNI EN ISO 9920 :2009	Ergonomia degli ambienti termici. Valutazione dell'isolamento termico e della resistenza evaporativa dell'abbigliamento.
UNI EN ISO 10077-1 :2018	Prestazione termica di finestre, porte e chiusure oscuranti. Calcolo della trasmittanza termica. Parte 1: Generalità
UNI EN ISO 10211 :2018	Ponti termici in edilizia. Calcolo dei flussi termici e delle temperature superficiali. Ponti termici lineari.
UNI EN 16798-1: 2019	Prestazione energetica degli edifici - Ventilazione per gli edifici - Parte 1: Parametri di ingresso dell'ambiente interno per la progettazione e la valutazione della prestazione energetica degli edifici in relazione alla qualità dell'aria interna, all'ambiente termico, all'illuminazione e all'acustica - Modulo M1-6
UNI EN 16798-3: 2018	Prestazione energetica degli edifici - Ventilazione per gli edifici - Parte 3: Per gli edifici non residenziali - Requisiti prestazionali per i sistemi di ventilazione e di condizionamento degli ambienti (Moduli M5-1, M5-4)
UNI EN 16798 (tutte)	Ventilazione per gli edifici
UNI EN 17192:2019	Ventilazione per gli edifici - Condotte - Condotte non metalliche - Requisiti e metodi di prova
UNI EN 12237: 2004	Ventilazione degli edifici - Reti delle condotte - Resistenza e tenuta delle condotte circolari di lamiera metallica
UNI EN 1507: 2008	Ventilazione degli edifici - Condotte rettangolari di lamiera metallica - Requisiti di resistenza e di tenuta
UNI EN 13180: 2004	Ventilazione degli edifici - Rete delle condotte - Dimensioni e requisiti meccanici per le condotte flessibili
UNI EN 1751: 2014	Ventilazione degli edifici - Dispositivi per la distribuzione dell'aria - Prove aerodinamiche delle serrande e delle valvole

Standards	System
UNI EN 12599: 2012	Ventilazione per edifici - Procedure di prova e metodi di misurazione per la presa in consegna di impianti di ventilazione e di condizionamento dell'aria
UNI EN 13403: 2004	Ventilazione degli edifici - Condotti non metallici - Rete delle condotte realizzata con pannelli di materiale isolante
UNI 10349-1 :2016	Riscaldamento e raffrescamento degli edifici - Dati climatici - Parte 1: Medie mensili per la valutazione della prestazione termo-energetica dell'edificio e metodi per ripartire l'irradianza solare nella frazione diretta e diffusa e per calcolare l'irradianza solare su di una superficie inclinata
UNI/TR 10349-2:2016	Riscaldamento e raffrescamento degli edifici - Dati climatici - Parte 2: Dati di progetto
UNI 10349-3:2016	Riscaldamento e raffrescamento degli edifici - Dati climatici - Parte 3: Differenze di temperatura cumulate (gradi giorno) ed altri indici sintetici
UNI EN ISO 52120-1:2022	Prestazione energetica degli edifici - Contributo dell'automazione, del controllo e della gestione tecnica degli edifici - Parte 1: Quadro generale e procedure
UNI/TS 11651:2023	Procedura di asseverazione per i sistemi di automazione e regolazione degli edifici in conformità alla UNI EN ISO 52120-1
UNI 10351 :2021	Materiali da costruzione - Proprietà termoigrometriche - Procedura per la scelta dei valori di progetto
UNI 10355 :1994	Murature e solai. Valori della resistenza termica e metodo di calcolo
UNI 10375 :2011	Metodo di calcolo della temperatura interna estiva degli ambienti
UNI 10389-1:2019	Generatori di calore. Misurazione in opera del rendimento di combustione. Parte 1: Generatori di calore a combustibile liquido e/o gassoso
UNI 10412-1 :2006	Impianti di riscaldamento ad acqua calda - Requisiti di sicurezza - Parte 1: Requisiti specifici per impianti con generatori di calore alimentati da combustibili liquidi, gassosi, solidi polverizzati o con generatori di calore elettrici
UNI 10412-2 :2009 EC 1-2012	Impianti di riscaldamento ad acqua calda - Prescrizioni di sicurezza - Parte 2: Requisiti specifici per impianti con apparecchi per il riscaldamento di tipo domestico alimentati a combustibile solido con caldaia incorporata, con potenza del focolare complessiva non maggiore di 35 kW
UNI 10641 :2022	Canne fumarie collettive a tiraggio naturale per apparecchi a gas di tipo C con ventilatore nel circuito di combustione - Progettazione e verifica
UNI 10847 :2017	Pulizia di sistemi fumari per generatori e apparecchi alimentati con combustibili liquidi e solidi - Linee guida e procedure
UNI 11169 :2006	Impianti di climatizzazione degli edifici - Impianti aeraulici ai fini di benessere - Procedure per il collaudo
UNI 11135 :2004	Condizionatori d'aria, refrigeratori d'acqua e pompe di calore. Calcolo dell'efficienza stagionale.
UNI/TS 11300-1 :2014	Prestazioni energetiche degli edifici. Parte 1: Determinazione del fabbisogno di energia termica dell'edificio per la climatizzazione estiva ed invernale

Standards	System
UNI/TS 11300-2 :2019	Prestazioni energetiche degli edifici - Parte 2: Determinazione del fabbisogno di energia primaria e dei rendimenti per la climatizzazione invernale, per la produzione di acqua calda sanitaria, per la ventilazione e per l'illuminazione in edifici non residenziali
UNI/TS 11300-3 :2010	Prestazioni energetiche degli edifici - Parte 3: Determinazione del fabbisogno di energia primaria e dei rendimenti per la climatizzazione estiva
UNI/TS 11300-4 :2016	Prestazioni energetiche degli edifici - Parte 4: Utilizzo di energie rinnovabili e di altri metodi di generazione per la climatizzazione invernale e per la produzione di acqua calda sanitaria
UNI/TS 11300-5:2016	Prestazioni energetiche degli edifici - Parte 5: Calcolo dell'energia primaria e della quota di energia da fonti rinnovabili
UNI/TS 11300-6:2016	Prestazioni energetiche degli edifici - Parte 6: Determinazione del fabbisogno di energia per ascensori, scale mobili e marciapiedi mobili
UNI EN ISO 52016-1:2018	Prestazione energetica degli edifici - Fabbisogni energetici per riscaldamento e raffrescamento, temperature interne e carichi termici sensibili e latenti - Parte 1: Procedure di calcolo
UNI EN ISO 52016-3:2023	Prestazione energetica degli edifici - Fabbisogni energetici per riscaldamento e raffrescamento, temperature interne e carichi termici sensibili e latenti - Parte 1: Procedure di calcolo
UNI EN ISO 52017-1:2018	Prestazione energetica degli edifici - Carichi termici sensibili e latenti e temperature interne - Parte 1: Procedure generali di calcolo
UNI 11354 :2015	Dispositivi di intercettazione per reti di distribuzione e/o trasporto del gas - Valvole a farfalla
UNI 11466 :2012	Sistemi geotermici a pompa di calore - Requisiti per il dimensionamento e la progettazione
UNI/TS 11487 :2013	Sistemi geotermici a pompa di calore - Requisiti per l'installazione di impianti ad espansione diretta
UNI 11513 :2013	Verifica in esercizio della taratura delle valvole di sicurezza mediante martinetti
UNI 11528 :2022	Impianti a gas di portata termica maggiore di 35 kW - Progettazione, installazione e messa in servizio
UNI EN 12098-1 :2023	Prestazione energetica degli edifici - Controllo per impianti di riscaldamento - Parte 1: Dispositivi di controllo per gli impianti di riscaldamento ad acqua calda - Moduli M3-5, 6, 7, 8
UNI EN 12098-3 :2023	Prestazione energetica degli edifici - Controllo per impianti di riscaldamento - Parte 3: Dispositivi di controllo per gli impianti di riscaldamento elettrici - Moduli M3-5, 6, 7, 8
UNI EN 12114 :2001	Prestazione termica degli edifici. Permeabilità all'aria dei componenti e degli elementi per edilizia. Metodo di prova di laboratorio.
UNI EN 12170 :2002	Impianto di riscaldamento degli edifici. Procedure per la predisposizione della documentazione per la conduzione, la manutenzione e l'esercizio. Impianti di riscaldamento che richiedono personale qualificato per la conduzione.

Standards	System
UNI EN 12171 :2002	Impianto di riscaldamento degli edifici. Procedure per la predisposizione della documentazione per la conduzione, la manutenzione e l'esercizio. Impianti di riscaldamento che non richiedono personale qualificato per la conduzione.
UNI EN 12220 :2001	Ventilazione degli edifici. Reti delle condotte. Dimensioni delle flange circolari per la ventilazione generale.
UNI EN 12428 :2013	Porte industriali, commerciali e da garage. Trasmittanza termica. Requisiti per il calcolo.
UNI EN 12446 :2011	Camini. Componenti. Elementi esterni di calcestruzzo.
UNI EN 12599 :2012	Ventilazione per edifici - Procedure di prova e metodi di misurazione per la presa in consegna di impianti di ventilazione e di condizionamento dell'aria
UNI EN 12828 :2014	Impianti di riscaldamento degli edifici. Progettazione dei sistemi di riscaldamento ad acqua.
UNI EN 12831 (tutte):2018	Impianti di riscaldamento negli edifici - Metodo di calcolo del carico termico di progetto
UNI EN 12975-1 :2022	Collettori solari - Requisiti generali
UNI EN 13141-2:2010	Ventilazione degli edifici - Verifica della prestazione di componenti/ prodotti per la ventilazione degli alloggi - Parte 2: Bocchette per l'estrazione e l'immissione dell'aria
UNI EN 13141-3:2018	Ventilazione per gli edifici - Verifica delle prestazioni di componenti per gli edifici residenziali - Parte 3: Cappe aspiranti per uso residenziale senza ventilatore
UNI EN 13141-4 :2021	Ventilazione per gli edifici - Verifica delle prestazioni di componenti per gli edifici residenziali - Parte 4: Prestazioni aerodinamiche, elettriche e acustiche delle unità di ventilazione unidirezionali
UNI EN 13141-5:2021	Ventilazione per gli edifici - Verifica delle prestazioni di componenti per gli edifici residenziali - Parte 5: Cappe, cappe assistite e dispositivi terminali di uscita dal tetto
UNI EN 13141-6 :2015	Ventilazione degli edifici - Verifica della prestazione di componenti/ prodotti per la ventilazione degli alloggi - Parte 6: Kit per impianti di estrazione per abitazioni unifamiliari
UNI EN 13141-7 :2021	Ventilazione per gli edifici - Verifica delle prestazioni di componenti per gli edifici residenziali - Parte 7: Test delle prestazioni delle unità di ventilazione meccanica canalizzata e di estrazione (compreso il recupero di calore)
UNI EN 13141-8:2022	Ventilazione per gli edifici - Prove di prestazione di componenti/prodotti per la ventilazione residenziale - Parte 8: Prove di prestazione di unità di ventilazione meccanica non canalizzate e di scarico (compreso il recupero del calore)
UNI EN 13141-9 :2008	Ventilazione degli edifici - Valutazione delle prestazioni di componenti/prodotti per la ventilazione degli alloggi - Parte 9: Dispositivi di immissione dell'aria igroregolabili montati all'esterno
UNI EN 13141-10 :2008	Ventilazione degli edifici - Valutazione delle prestazioni di componenti/prodotti per la ventilazione degli alloggi - Parte 10: Dispositivi di estrazione dell'aria igroregolabili

Standards	System
UNI EN 13141-11 :2015	Ventilazione degli edifici - Verifica della prestazione di componenti/prodotti per la ventilazione degli alloggi - Parte 11: Unità di ventilazione di immissione
UNI EN ISO 13370 :2018	Prestazioni termiche degli edifici. Trasferimento del calore attraverso il terreno. Metodi di calcolo.
UNI EN 13384-1 :2019	Camini - Metodi di calcolo termo e fluido dinamico - Parte 1: Camini asserviti a un unico apparecchio a combustione
UNI EN 13384-2 :2019	Camini - Metodi di calcolo termo e fluido dinamico - Parte 2: Camini asserviti a più apparecchi a combustione
UNI EN 13384-3:2006	Camini - Metodi di calcolo termico e fluido dinamico - Parte 3: Metodi per l'elaborazione di diagrammi e tabelle per camini asserviti ad un solo apparecchio di riscaldamento
UNI EN 16798 (tutte)	Prestazione energetica degli edifici - Ventilazione per gli edifici
UNI EN 16798-3 :2018	Prestazione energetica degli edifici - Ventilazione per gli edifici - Parte 3: Per gli edifici non residenziali - Requisiti prestazionali per i sistemi di ventilazione e di condizionamento degli ambienti (Moduli M5-1, M5-4)
UNI EN 16798-7:2018	Prestazione energetica degli edifici - Ventilazione per gli edifici - Parte 7: Metodi di calcolo per la determinazione delle portate d'aria negli edifici compresa l'infiltrazione (Moduli M5-5)
UNI EN ISO 13786 2018	Prestazioni termica dei componenti per l'edilizia. Caratteristiche termiche dinamiche. Metodi di calcolo.
UNI EN ISO 13789 :2018	Prestazione termica degli edifici. Coefficiente di perdita del calore per trasmissione. Metodo di calcolo.
UNI EN ISO 9972:2015	Prestazione termica degli edifici. Determinazione della permeabilità all'aria degli edifici. Metodo di pressurizzazione mediante ventilatore.
UNI EN 13941-1 :2022	Tubazioni per teleriscaldamento - Progettazione ed installazione di tubazioni preisolate, singole o doppie, per reti di acqua calda interrate direttamente - Parte 1: Progettazione
UNI EN 13941-2:2022	Tubazioni per teleriscaldamento - Progettazione ed installazione di tubazioni preisolate, singole o doppie, per reti di acqua calda interrate direttamente - Parte 2: Installazione
UNI EN 14037-1 :2016	Strisce radianti a soffitto alimentate con acqua a temperatura minore di 120°C – Parte 1: Specifiche tecniche e requisiti.
UNI EN 14037-2 :2016	Strisce radianti a soffitto alimentate con acqua a temperatura minore di 120°C – Parte 2: Metodo di prova per determinare la potenza termica.
UNI EN 14037-3 :2016	Strisce radianti a soffitto alimentate con acqua a temperatura minore di 120°C – Parte 3: Determinazione della potenza nominale e valutazione della potenza termica radiante.
UNI EN 14037-4:2016	Pannelli radianti sospesi a soffitto per riscaldamento e raffrescamento alimentati con acqua a temperatura minore di 120°C - Parte 4: Pannelli radianti prefabbricati a soffitto - Metodo di prova per determinare la potenza frigorifera

Standards	System
UNI EN 14037-5:2016	Pannelli radianti sospesi a soffitto per riscaldamento e raffrescamento alimentati con acqua a temperatura minore di 120°C - Parte 5: Soffitti per riscaldamento aperti o chiusi - Metodo di prova per determinare la potenza termica
UNI EN ISO 15758:2016	Isolamento termico degli impianti di riscaldamento e raffrescamento degli edifici
UNI EN 14336 :2004	Impianti di riscaldamento negli edifici. Installazione e messa in servizio dei sistemi di riscaldamento ad acqua calda.
UNI EN 14419 :2009	Tubazioni per teleriscaldamento. Sistemi bloccati di tubazioni preisolate per reti di acqua calda interrate direttamente. Sistemi di sorveglianza.
UNI EN 14471 :2015	Camini. Sistemi di camini con condotti interni di plastica. Requisiti e metodo di prova.
UNI EN ISO 12631:2018	Prestazione termica delle facciate continue - Calcolo della trasmittanza termica
UNI EN ISO 14683 :2018	Ponti termici in edilizia. Coefficiente di trasmissione termica lineica. Metodi semplificati e valori di riferimento.
UNI EN 14825 :2022	Condizionatori d'aria, refrigeratori di liquidi e pompe di calore, con compressori azionati elettricamente, per il riscaldamento e il raffreddamento degli ambienti, il raffreddamento commerciale e di processo - Prove e valutazione a carico parziale e calcolo delle prestazioni stagionali
UNI EN 15116 :2008	Ventilazione degli edifici - Travi fredde - Prove e valutazione delle travi fredde attive
UNI EN ISO 52003-1:2018	Prestazione energetica degli edifici - Indicatori, requisiti, valutazioni e certificati - Parte 1: Aspetti generali e applicazione alla prestazione energetica complessiva
UNI EN 15316 (parti da 1 a 5): 2018	Metodo di calcolo per le richieste di energia e delle efficienze del sistema
UNI EN ISO 11855:2024 (tutte)	Progettazione dell'ambiente costruito - Progettazione, dimensionamento, installazione e controllo dei sistemi di riscaldamento e raffreddamento radianti integrati
UNI EN 15450 :2008	Impianti di riscaldamento negli edifici - Progettazione degli impianti di riscaldamento a pompa di calore
UNI EN 15780 :2011	Ventilazione degli edifici - Condotti - Pulizia dei sistemi di ventilazione
UNI EN ISO 15927-1 :2004	Prestazione termo igrometrica degli edifici. Calcolo e presentazione dei dati climatici. Medie mensili dei singoli elementi meteorologici.
UNI EN ISO 15927-2 :2009	Prestazione termoigrometrica degli edifici - Calcolo e presentazione dei dati climatici - Parte 2: Dati orari per il carico di raffrescamento di progetto

Standards	System
UNI EN ISO 15927-3 :2009	Prestazione termoigrometrica degli edifici - Calcolo e presentazione dei dati climatici - Parte 3: Calcolo di un indice di pioggia battente per superfici verticali a partire dai dati orari di vento e di pioggia
UNI EN ISO 15927-4 :2005	Prestazione termo igrometrica degli edifici. Calcolo e presentazione dei dati climatici. Parte 4: Dati orari per la valutazione del fabbisogno annuale di energia per il riscaldamento e il raffrescamento.
UNI EN ISO 15927-5 :2012	Prestazione termoigrometrica degli edifici - Calcolo e presentazione dei dati climatici - Parte 5: Dati per il carico termico di progetto per il riscaldamento degli ambienti
UNI EN ISO 16000-32 :2015	Aria in ambienti confinati - Parte 32: Indagine per verificare la presenza di inquinanti negli edifici
UNI EN 16430-1 :2015	Radiatori ventilati, convettori e convettori a pavimento - Parte 1: Specifiche tecniche e requisiti
UNI EN 16430-2 :2015	Radiatori ventilati, convettori e convettori a pavimento - Parte 2: Metodi di prova e valutazione della potenza termica
UNI EN 16430-3 :2015	Radiatori ventilati, convettori e convettori a pavimento - Parte 3: Metodi di prova e valutazione della potenza termica in raffrescamento
UNI EN 16497-1 :2015	Camini - Sistemi camino in calcestruzzo - Parte 1: Sistemi a flusso non bilanciato
UNI EN ISO 23553-1 :2022	Dispositivi di sicurezza e controllo per apparecchi e bruciatori ad olio combustibile - Requisiti particolari - Parte 1: Valvole automatiche e semiautomatiche
UNI EN ISO 23993 :2011	Isolanti termici per gli impianti degli edifici e per le installazioni industriali - Determinazione della conduttività termica di progetto
UNI CIG (tutte)	Norme per la sicurezza dell'impiego del gas combustibile.

27.1.2 Reference UNI standards for plumbing and sanitary systems.

Standards	System
UNI EN 476:2022	Requisiti generali per componenti utilizzati nelle connessioni di scarico e nei collettori di fognatura per sistemi di scarico a gravità
UNI EN 806-1 :2008	Specifiche relative agli impianti all'interno di edifici per il convogliamento di acque destinate al consumo umano - Parte 1: Generalità
UNI EN 806-2 :2008	Specifiche relative agli impianti all'interno di edifici per il convogliamento di acque destinate al consumo umano - Parte 2: Progettazione
UNI EN 806-3 :2008	Specifiche relative agli impianti all'interno di edifici per il convogliamento di acque destinate al consumo umano - Parte 3: Dimensionamento delle tubazioni - Metodo semplificato
UNI 8065 :2019 + EC 1-2019	Trattamento dell'acqua negli impianti per la climatizzazione invernale ed estiva, per la produzione di acqua calda sanitaria e negli impianti solari termici

Standards	System
UNI 9182 :2014	Impianti di alimentazione e distribuzione di acqua fredda e calda. Criteri di progettazione, collaudo e gestione
UNI EN ISO 9806 :2018	Energia solare - Collettori solari termici - Metodi di prova
UNI EN ISO 9488 :2022	Energia solare. Vocabolario.
UNI 10637 :2024	Piscine ad uso pubblico - Requisiti degli impianti di circolazione, filtrazione, disinfezione e trattamenti chimico-fisici dell'acqua di piscina
UNI/TS 11445 :2012 EC 1-2012	Impianti per la raccolta e utilizzo dell'acqua piovana per usi diversi dal consumo umano - Progettazione, installazione e manutenzione
UNI EN 12050-1 :2015	Impianti di sollevamento delle acque reflue per edifici e cantieri - Parte 1: Impianti di sollevamento per acque reflue contenenti materiale fecale
UNI EN 12050-2 :2015	Impianti di sollevamento delle acque reflue per edifici e cantieri - Parte 2: Impianti di sollevamento per acque reflue prive di materiale fecale
UNI EN 12050-3 :2015	Impianti di sollevamento delle acque reflue per edifici e cantieri - Parte 3: Impianti di sollevamento per acque reflue per applicazioni limitate
UNI EN 12050-4 :2015	Impianti di sollevamento delle acque reflue per edifici e cantieri - Parte 4: Valvole di non-ritorno per acque reflue prive di materiale fecale e per acque reflue contenenti materiale fecale
UNI EN 12056-(tutte) :2001	Sistemi di scarico funzionanti a gravità all'interno degli edifici
UNI EN 12566-3 :2013	Piccoli sistemi di trattamento delle acque reflue fino a 50 PT - Parte 3: Impianti di trattamento preassemblati e/o assemblati in sito delle acque reflue domestiche
UNI EN 12975:2022	Collettori solari. Requisiti generali.
UNI EN 14654-3 :2021	Gestione e controllo delle attività operative negli impianti di raccolta e smaltimento di acque reflue all'esterno di edifici - Parte 3: Pulizia negli impianti di raccolta e smaltimento di acque reflue
UNI CEN/TR 16355 :2012	Raccomandazioni per la prevenzione della crescita della legionella negli impianti all'interno degli edifici che convogliano acqua per il consumo umano
UNI EN 442-1 :2015	Radiatori e convettori. Parte 1: Specifiche tecniche e requisiti

27.1.3 Reference UNI standards for fire protection systems.

Standards	System
UNI EN 694 :2014	Tubazioni antincendio - Tubazioni semirigide per sistemi fissi
UNI EN 1366-1 :2020	Prove di resistenza al fuoco per impianti di fornitura servizi - Parte 1: Condotte di ventilazione
UNI EN 1366-2 :2015	Prove di resistenza al fuoco per impianti di fornitura servizi - Parte 2: Serrande tagliafuoco

Standards	System
UNI EN 1366-3 :2022	Prove di resistenza al fuoco per impianti di fornitura servizi - Parte 3: Sigillanti per attraversamenti
UNI EN 1366-5:2021	Prove di resistenza al fuoco per impianti di fornitura servizi - Parte 5: Canalizzazioni di servizio e cavedi
UNI EN 1366-12 :2014	Prove di resistenza al fuoco per impianti di fornitura servizi - Parte 12: Barriere tagliafuoco non meccaniche per le condotte di ventilazione
UNI EN 1366-13:2019	Prove di resistenza al fuoco per impianti di fornitura servizi - Parte 13: Camini
UNI EN 1568-(tutte) :2018 EC 1-2010	Mezzi di estinzione incendi - Liquidi schiumogeni concentrati
UNI EN 1866-2 :2014	Estintori d'incendio carrellati - Parte 2: Requisiti per la fabbricazione, resistenza a pressione e prove meccaniche per estintori, con una pressione massima ammissibile uguale o minore di 30 bar, che sono conformi ai requisiti espressi nella EN 1866-1
UNI EN 1866-3 :2013	Estintori d'incendio carrellati - Parte 3: Requisiti per l'assemblaggio, la fabbricazione e la resistenza a pressione di estintori a CO2 conformi ai requisiti della EN 1866-1
UNI 9487 :2006	Apparecchiature per estinzione incendi - Tubazioni flessibili antincendio di DN 70 per pressioni di esercizio fino a 1,2 MPa
UNI 9494-1:2017	Sistemi per il controllo di fumo e calore - Parte 1: Progettazione e installazione dei Sistemi di Evacuazione Naturale di Fumo e Calore (SENFC)
UNI 9494-2:2017	Sistemi per il controllo di fumo e calore - Parte 2: Progettazione e installazione dei Sistemi di Evacuazione Forzata di Fumo e Calore (SEFFC)
UNI 9494-3:2014	Sistemi per il controllo di fumo e calore - Parte 3: Controllo iniziale e manutenzione dei sistemi di evacuazione di fumo e calore
UNI 9994-1:2013	Apparecchiature per estinzione incendi - Estintori di incendio - Parte 1: Controllo iniziale e manutenzione
UNI 10779 :2021	Impianti di estinzione incendi - Reti di idranti - Progettazione, installazione ed esercizio
UNI 11292 :2019	Locali destinati ad ospitare gruppi di pompaggio per impianti antincendio - Caratteristiche costruttive e funzionali
UNI 11443 :2012 EC 1-2014	Sistemi fissi antincendio - Sistemi di tubazioni - Valvole di intercettazione antincendio
UNI/TS 11559 :2014	Impianti di estinzione incendi - Reti di idranti a secco - Progettazione, installazione ed esercizio
UNI EN 12094-(tutte)	Sistemi fissi di lotta contro l'incendio - Componenti di impianti di estinzione a gas -
UNI EN 12259-1 :2007	Installazioni fisse antincendio - Componenti per sistemi a sprinkler e a spruzzo d'acqua - Parte 1: Sprinkler

Standards	System
UNI EN 12845 :2020	Installazioni fisse antincendio - Sistemi automatici a sprinkler. Progettazione, installazione e manutenzione
UNI/TR 11438:2016	Installazioni fisse antincendio - Gruppi di pompaggio - Istruzioni complementari per l'applicazione della UNI EN 12845 (sprinkler)
UNI EN 14339 :2006	Idranti antincendio sottosuolo
UNI EN 14384 :2006 EC 2-2011	Idranti antincendio a colonna soprasuolo
UNI EN 14540 :2014	Tubazioni antincendio - Tubazioni appiattibili impermeabili per impianti fissi
UNI CEN/TS 14816 :2009	Installazioni fisse antincendio - Sistemi spray ad acqua - Progettazione, installazione e manutenzione
UNI EN 15004-(tutte)	Installazioni fisse antincendio - Sistemi a estinguenti gassosi
UNI EN 15423 :2008	Ventilazione degli edifici - Misure antincendio per i sistemi di distribuzione dell'aria negli edifici
UNI EN 15276-1:2019	Sistemi fissi di lotta contro l'incendio - Sistemi di estinzione ad aerosol condensato - Parte 1: Requisiti e metodi di prova per i componenti
UNI EN 15276-2:2019	Sistemi fissi di lotta contro l'incendio - Sistemi di estinzione ad aerosol condensato - Parte 2: Progettazione, installazione e manutenzione

28.0 PRE-QUALIFIED SUPPLIERS AND MANUFACTURERS

01 Where a specific manufacturer is not stated, a manufacturer or supplier shall be selected from the list of preferred and alternative preferred manufacturers listed below. The Contractor Shall adhere to this schedule for the stated plant and equipment.

02 The M&PH Services Contractor may propose alternatives to the schedule, but these shall be separately detailed, and the cost savings highlighted. In their submission, the Contractor shall include a full technical submission detailing his proposal. Unless clearly stated otherwise, the Tender submission shall be deemed to include preferred manufactures and suppliers' plant and equipment.

03 All plant and equipment provided for this project shall be from a manufacturer or suppliers standard range of equipment.

04 The Contractor shall provide confirmation that all plant and equipment selected has been successfully installed and operated in similar applications to the satisfaction of the Client or the Consultant. This process shall be concluded before any plant or equipment is ordered by the Contractor.

05 Any manufacturer or sub-Contractor provided by the Contractor shall have an established 24/7 maintenance service located within the Frankfurt am Main region of at least 5 years' history.

Item	Pre-Qualified Suppliers & Manufacturers
Air Handling Units	Roccheggiani, Daikin; Zoppellaro.

Item	Pre-Qualified Suppliers & Manufacturers
Extract Fans	Flakt Group
Heat Pumps & DX fan coils	LG, Mitsubishi Electric; Daikin.
VRF System to Offices	LG, Mitsubishi Electric; Daikin.
Pumps	Grundfos; Wilo, KSB
Packaged Pressurisation and Expansion Units	IMI Hydronics
Water Booster Sets	Grundfos; Wilo, KGN Pillinger, Aquatech.
Grilles and Diffusers	Tecnoventil, Trox, Systemair.
Fire Dampers	Tecnoventil; MP3, Systemair.
Motorised Smoke Dampers	Tecnoventil; Trox, Systemair.
Side Stream Filtration	Culligan, Termoacqua
Vacuum Degasser	IMI Hydronics, Spirotech, Flamco.
Water treatment	Culligan, Termoacqua
BMS	Schneider Electric, Siemens, Automated Logic
Firefighting System	Bocciolone, Tyco, Viking
Calcium silicate ducts	Roccheggiani, Promat, Aernova
Pressurized smoke filter	SACOP, Flaktwood
SEFFC/SFM System fans	Aernova, Caoduro, Bovema, Systemair
Heat pump for DHW	Vaillant, Ariston
Continuous cooling storage tank	Fiorini, ABC, Pacetti
Firefighting storage tank	GFS Srl
Firefighting pumps	GFS Srl
Heat Tracing	TTK, Temar
Leak detection	TTK, Temar
Nitrogen generator	Potter
Precision air conditioners	Schneider, Vertiv, Hiref, Stulz
Electric heaters	Sabiana
Electric air curtains	Systemair, Flaktwood
Ceiling mounted heat recovery units	Roccheggiani, Zoppellaro, Sabiana, Systemair
Smoke barriers	Aernova, Caoduro, Bovema
Seismic pipe joints	Bocciolone, Prosystem, Kayse
Hangers	Hilti, Prosystem
Attenuators for air handling systems	Lindab, Sagicofim

Item	Pre-Qualified Suppliers & Manufacturers
Lifting stations for sewage, stormwater and plant water	Grundfos, KSB, WILO
PEHD,PE pipes	Rototec, +GF+, ISEA
Cast iron pipes	Saint Gobain PAM
Grease separators, tanks and purification	ISEA, Plastomec, Edilcop
Oil separators for oilwater system	Edilcop
Lamination tanks	Coprem
Precast concrete containment tanks	Edilcop
Manholes for external systems	Edilcop
Hydraulic valves and accessories	Bray, Ksb, Cazzanoga, Danfoss, Caleffi
Pressure independent valves	Belimo
Manual flow limiting valves	Frese
Diesel shut-off valves	Bray
MV Switchgear	SCHNEIDER - ABB – SIEMENS – VERTIV
Transformers	SCHNEIDER - ABB – SIEMENS – ORBEA
LV Switchboards	SCHNEIDER – ABB – SIEMENS – VERTIV
Apparecchiature quadri BT	SCHNEIDER – ABB – SIEMENS
Distribution Busbars	EAE – Schneider – Zucchini – Pogliano – Graziadio – Vertiv
Data Hall Busbars	EAE – Starline – Vertiv
Power Meters / Power Quality Meters	Socomec – Schneider – ABB – Siemens - Janitza
SPDs	RONCARATI - CONTRADE – DEHN - ZOTUP
Emergency Light Fittings	LINERGY – BEGHELLI – ZUMTOBELL - DIN
Internal Light Fittings	TRILUX – EAE - DISANO
External Light Fittings	TRILUX – DISANO – EAC
EPMS	Schneider Electric – Siemens - Automated Logic
Secure Trunking	Legrand Salamandre
KNX / DALI Management	THEBEN AG - SCHNEIDER - ABB - SIEMENS
Electromagnetic shielding	G-Iron – BE Shielding
Smoke Detection System	SIEMENS – DEF – NOTIFIER – TELEDATA - ESSER
Public Address EVAC	TUTONDO – NOTIFIER - TELEDATA - BOSH
Video Intercom	bTICINO – Comelit
EV Chargers	E-station – Schneider – ABB

Item	Pre-Qualified Suppliers & Manufacturers
Emergency Call Points	Comelit – Commend
PV system	ABB – Sun Power - Schneider
Fire Barriers	AF System – Hilti – Roxtec - Legrand
4G/5G Cell Phones Coverage	Inwitt
Copper Cabling cables / accessories	Panduit
O.F: Cabling cables / accessories	Commscope

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APPENDIX A –PROJECT DOCUMENTS LIST

01 This Appendix includes the issue register referenced “MIL08A-BWE-XX-XX-RG-N-00002” for the concise list of the deliverables provided part of this Stage 3 Employer Requirements Pack.

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Master Information Delivery Plan (MIDP)

Client	STACK
Project Number	P10500
Project Title	MIL08A
Task Team Role	MEP LEAD
Date Created	1/20/2025
TIDP Version	v1 03/09/2024
Document Reference	MIL08A-BWE-XX-XX-RG-N-00002
Suitability	S2 - Suitable for Information

							STAGE 3		
							100% DEVELOPED DESIGN		
DOCUMENT REFERENCE	**DESCRIPTION**	**DISCIPLINE**	**CURRENT REVSION**	**EXCHANGE FORMATS**	**SCALE**	**SIZE**	**REQUIRED DATE**	**ISSUED DATE**	**REVISION**
ARCHITECTURAL									
MODEL									
MIL08A-L22-DC-XX-M3-A-00001	Architectural - Building Model	Architectural	P01	RVT	N/A	N/A	17.Jan.25	17.Jan.25	P01
MIL08A-L22-SW-XX-M3-A-10001	Architectural - Context model	Architectural	P01	RVT	N/A	N/A	17.Jan.25	17.Jan.25	P01
MIL08A-L22-SW-XX-M3-A-10002	Architectural - Site Model	Architectural	P01	RVT	N/A	N/A	17.Jan.25	17.Jan.25	P01
MIL08A-L22-DC-XX-M3-F-00001	Fire safety building model	Architectural	P01	RVT	N/A	N/A	17.Jan.25	17.Jan.25	P01
ACOUSTIC - DOCUMENTS									
MIL08A-L22-XX-XX-CA-ACO-00001	Environmental Acoustic Impact Assessment	Acoustic	P01	PDF	N/A	N/A	17.Jan.24	17.Jan.24	P01
DRAWINGS									
GENERAL									
MIL08A-L22-SW-SW-DR-A-10101	Customer spaces layout - Parking	Architectural	P02	PDF	1:500	A0	17.Jan.25	17.Jan.25	P02
MIL08A-L22-SW-SW-DR-A-10201	General Plan and site total area	Architectural	P02	PDF	1:500	A0	17.Jan.25	17.Jan.25	P02
MIL08A-L22-SW-XX-DR-A-10201	General Plan and urban section Existing Condition	Architectural	P02	PDF	1:500	A0	17.Jan.25	17.Jan.25	P02
MIL08A-L22-SW-XX-DR-A-10202	General Plan and urban section Comparison	Architectural	P02	PDF	1:500	A0	17.Jan.25	17.Jan.25	P02
MIL08A-L22-SW-XX-DR-A-10203	General Plan and urban section Project Status	Architectural	P02	PDF	1:500	A0	17.Jan.25	17.Jan.25	P02
MIL08A-L22-DC-0G-DR-A-20101	Customer spaces layout - IDF rooms	Architectural	P02	PDF	1:250	A0	17.Jan.25	17.Jan.25	P02
MIL08A-L22-DC-ZZ-DR-A-20102	Rack and personel path	Architectural	P02	PDF	1:250	A0	17.Jan.25	17.Jan.25	P02
MIL08A-L22-DC-ZZ-DR-A-20103	Customer spaces layout - Premises	Architectural	P02	PDF	1:250	A0	17.Jan.25	17.Jan.25	P02
MIL08A-L22-DC-ZZ-DR-A-20104	Customer spaces layout - Offices	Architectural	P02	PDF	1:250	A0	17.Jan.25	17.Jan.25	P02
MIL08A-L22-DC-ZZ-DR-A-20105	Customer spaces layout - Storages	Architectural	P02	PDF	1:250	A0	17.Jan.25	17.Jan.25	P02
MIL08A-L22-DC-0G-DR-A-20106	Customer spaces layout - Entrance Room	Architectural	P02	PDF	1:250	A0	17.Jan.25	17.Jan.25	P02
MIL08A-L22-DC-XX-DR-A-20201	Data hall layout and section	Architectural	P02	PDF	1:250	A0	17.Jan.25	17.Jan.25	P02
MIL08A-L22-DC-ZZ-DR-A-20201	General Plan Layout	Architectural	P02	PDF	1:500	A0	17.Jan.25	17.Jan.25	P02
MIL08A-L22-DC-0G-DR-A-20201	Office Data Hall Level 00 Plan	Architectural	P02	PDF	1:200	A0	17.Jan.25	17.Jan.25	P02
MIL08A-L22-DC-01-DR-A-20201	Office Data Hall Level 01 Plan	Architectural	P02	PDF	1:200	A0	17.Jan.25	17.Jan.25	P02
MIL08A-L22-DC-RF-DR-A-20201	Office Data Hall Roof Level Plan	Architectural	P02	PDF	1:200	A0	17.Jan.25	17.Jan.25	P02
MIL08A-L22-DC-XX-DR-A-20401	Typical Section	Architectural	P02	PDF	1:200	A0	17.Jan.25	17.Jan.25	P02
MIL08A-L22-DC-XX-DR-A-20402	Typical Elevation	Architectural	P02	PDF	1:200	A0	17.Jan.25	17.Jan.25	P02
MIL08A-L22-DC-XX-DR-A-26801	Fire and Life Safety Multiple Levels Plan and Section	Architectural	P02	PDF	1:200	A0	17.Jan.25	17.Jan.25	P02
MIL08A-L22-SW-SW-DR-A-10105	Access and Internal Circulation Roof Level	Architectural	P01	PDF	1:500	A0	17.Jan.25	17.Jan.25	P01
MIL08A-L22-SW-ZZ-DR-A-20203	Outdoor Areas Plan and Details	Architectural	P01	PDF	1:500	A0	17.Jan.25	17.Jan.25	P01
MIL08A-L22-SW-ZZ-DR-A-20201	Details of outdoor elements	Architectural	P01	PDF	1:500	A0	17.Jan.25	17.Jan.25	P01
MIL08A-L22-SW-XX-DR-A-20201	Outdoor cabins	Architectural	P01	PDF	1:500	A0	17.Jan.25	17.Jan.25	P01
MIL08A-L22-SW-ZZ-DR-A-20202	Road Finishes	Architectural	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-L22-DC-XX-DR-A-89202	Bathrooms	Architectural	P01	PDF	1:50	A0	17.Jan.25	17.Jan.25	P01
MIL08A-L22-DC-0G-DR-A-22201	Walls Level 00 Layout	Architectural	P01	PDF	1:200	A0	17.Jan.25	17.Jan.25	P01
MIL08A-L22-DC-ZZ-DR-A-22201	Walls Multiple Levels	Architectural	P01	PDF	1:200	A0	17.Jan.25	17.Jan.25	P01
MIL08A-L22-DC-0G-DR-A-20202	Door and Window Level 00 Plan	Architectural	P01	PDF	1:200	A0	17.Jan.25	17.Jan.25	P01
MIL08A-L22-DC-ZZ-DR-A-20203	Door/Window Multiple Levels	Architectural	P01	PDF	1:200	A0	17.Jan.25	17.Jan.25	P01
MIL08A-L22-DC-0G-DR-A-23201	Floors Level 00 Plan	Architectural	P01	PDF	1:200	A0	17.Jan.25	17.Jan.25	P01
MIL08A-L22-DC-01-DR-A-23201	Floors Level 01 Plan	Architectural	P01	PDF	1:200	A0	17.Jan.25	17.Jan.25	P01
MIL08A-L22-DC-RF-DR-A-23201	Floors Roof Level Plan	Architectural	P01	PDF	1:200	A0	17.Jan.25	17.Jan.25	P01
MIL08A-L22-DC-0G-DR-A-35201	Ceilings Level 00 Plan	Architectural	P01	PDF	1:200	A0	17.Jan.25	17.Jan.25	P01
MIL08A-L22-DC-ZZ-DR-A-35201	Ceilings Level 01 Plan	Architectural	P01	PDF	1:200	A0	17.Jan.25	17.Jan.25	P01
MIL08A-L22-DC-ZZ-DR-A-42201	Finishes and skirtings	Architectural	P01	PDF	1:200	A0	17.Jan.25	17.Jan.25	P01
MIL08A-L22-DC-XX-DR-A-89203	Gantry Fence	Architectural	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-L22-DC-XX-DR-A-22201	Wall Abacus	Architectural	P01	PDF	1:20	A0	17.Jan.25	17.Jan.25	P01
MIL08A-L22-DC-XX-DR-A-89204	Wall Sections	Architectural	P01	PDF	1:20	A0	17.Jan.25	17.Jan.25	P01
MIL08A-L22-DC-XX-DR-A-89205	Door Abacus Details	Architectural	P01	PDF	1:20	A0	17.Jan.25	17.Jan.25	P01
MIL08A-L22-DC-XX-DR-A-89201	Door-Window Abacus	Architectural	P01	PDF	1:20	A0	17.Jan.25	17.Jan.25	P01
MIL08A-L22-DC-XX-DR-A-23201	Floor Abacus Details	Architectural	P01	PDF	1:20	A0	17.Jan.25	17.Jan.25	P01
MIL08A-L22-DC-ZZ-DR-A-20202	General Plan Layout Office	Architectural	P01	PDF	1:200	A0	17.Jan.25	17.Jan.25	P01
MIL08A-L22-DC-0G-DR-A-89201	Data Hall Level 00 Layout	Architectural	P01	PDF	1:200	A0	17.Jan.25	17.Jan.25	P01
MIL08A-L22-DC-0G-DR-A-89202	Data Hall Level 00 Layout, Sheet 2	Architectural	P01	PDF	1:200	A0	17.Jan.25	17.Jan.25	P01
MIL08A-L22-DC-0G-DR-A-89203	Data Hall Level 00 Layout, Sheet 3	Architectural	P01	PDF	1:200	A0	17.Jan.25	17.Jan.25	P01
MIL08A-L22-DC-0G-DR-A-89204	Data Hall Level 00 Layout, Sheet 4	Architectural	P01	PDF	1:200	A0	17.Jan.25	17.Jan.25	P01
MIL08A-L22-SW-0G-DR-A-20201	Sitewide	Architectural	P01	PDF	1:250	A0	17.Jan.25	17.Jan.25	P01
STRUCTURAL /Civil									
REGISTER									
MIL08A-L22-XX-XX-RG-Z-00001	L22 TIDP	Structural		xls	N/A	A3			
MODELS									
MIL08A-L22-SW-XX-M3-M-00001	Mechanical Site Model	Civil	P01	RVT/NWC	N/A	N/A	17.Jan.24	17.Jan.24	P01
MIL08A-L22-SW-XX-M3-E-00001	Electrical Site Model	Civil	P01	RVT/NWC	N/A	N/A	17.Jan.24	17.Jan.24	P01
MIL08A-SPS-ZZ-XX-M3-S-00001	Structural Model	Structural	P01	RVT/NWC	N/A	N/A	17.Jan.24	17.Jan.24	P01
MECHANICAL - DRAWINGS									
SERIES 90 - External Services									
MIL08A-L22-SW-SW-DR-M-90201	External Services Sitewide Potable and Non-Potable Water	Civil	P03	PDF	1:250	A0	17.Jan.24	17.Jan.24	P03
MIL08A-L22-SW-SW-DR-M-90202	External Services Sitewide Soil and Industrial Water Drainage	Civil	P03	PDF	1:250	A0	17.Jan.24	17.Jan.24	P03
MIL08A-L22-SW-SW-DR-M-90203	External Sitewide Rainwater Drainage	Civil	P03	PDF	1:250	A0	17.Jan.24	17.Jan.24	P03
MIL08A-L22-SW-SW-DR-M-90204	External Sitewide Oilwater Drainage	Civil	P03	PDF	1:250	A0	17.Jan.24	17.Jan.24	P03
MIL08A-L22-SW-SW-DR-M-90205	External Services Sitewide Firefighting	Civil	P03	PDF	1:250	A0	17.Jan.24	17.Jan.24	P03
MIL08A-L22-SW-SW-DR-M-90206	External Services Sitewide Heat Rejection Recovery System	Civil	P01	PDF	1:250	A0	17.Jan.24	17.Jan.24	P01
MIL08A-L22-SW-SW-DR-M-90207	External Services Sitewide Fuel Tanks Piping	Civil	P01	PDF	1:250	A0	17.Jan.24	17.Jan.24	P01
MIL08A-L22-SW-SW-DR-M-90208	External Services Sitewide Overall	Civil	P01	PDF	1:250	A0	17.Jan.24	17.Jan.24	P01
MECHANICAL - REPORTS									
MIL08A-L22-SW-SW-SP-M-90001	Underground Mechanical System - Technical Specifications	Civil	P01	PDF	N/A	A4	07.Feb.24		P01
MIL08A-L22-SW-SW-BQ-M-90001	Underground Mechanical System - Price Bill of Quantity	Civil	P01	PDF	N/A	A4	07.Feb.24		P01
MIL08A-L22-SW-SW-BQ-M-90002	Underground Mechanical System - Bill of Quantity	Civil	P01	PDF	N/A	A4	07.Feb.24		P01
MIL08A-L22-SW-SW-BQ-M-90003	Underground Mechanical System - Priced List	Civil	P01	PDF	N/A	A4	07.Feb.24		P01
MIL08A-L22-SW-SW-RP-M-90001	Underground Mechanical System - Technical Report	Civil	P01	PDF	N/A	A4	07.Feb.24		P01
MIL08A-L22-ZZ-XX-SP-M-00001	Mechanical System - Technical Specifications	Civil	P01	PDF	N/A	A4	07.Feb.24		P01
MIL08A-L22-ZZ-XX-BQ-M-00001	Mechanical System - Price Bill of Quantity	Civil	P01	PDF	N/A	A4	07.Feb.24		P01
MIL08A-L22-ZZ-XX-BQ-M-00002	Mechanical System - Bill of Quantity	Civil	P01	PDF	N/A	A4	07.Feb.24		P01
MIL08A-L22-ZZ-XX-BQ-M-00003	Mechanical System - Price List	Civil	P01	PDF	N/A	A4	07.Feb.24		P01
MECHANICAL - DOCUMENTS									
MIL08A-L22-DC-XX-CA-M-00001	Underground Mechanical System – Calculation Report	Civil	P01	PDF	N/A	N/A	17.Jan.24	17.Jan.24	P01
ELECTRICAL - DRAWINGS									
SERIES 90 - External Services									
MIL08A-L22-SW-SW-DR-E-90201	Underground Electrical System - Sitewide Medium Voltage Layout - Overview	Civil	P03	PDF	1:250	A0	17.Jan.24	17.Jan.24	P03
MIL08A-L22-SW-SW-DR-E-90202	Underground Electrical System - Sitewide Client Fiber Optic Layout - Overview	Civil	P03	PDF	1:250	A0	17.Jan.24	17.Jan.24	P03
MIL08A-L22-SW-SW-DR-E-90203	Underground Electrical System - Sitewide Stack Fiber Optic Layout - Overview	Civil	P03	PDF	1:250	A0	17.Jan.24	17.Jan.24	P03

							STAGE 3		
							100% DEVELOPED DESIGN		
DOCUMENT REFERENCE	**DESCRIPTION**	**DISCIPLINE**	**CURRENT REVSION**	**EXCHANGE FORMATS**	**SCALE**	**SIZE**	**REQUIRED DATE**	**ISSUED DATE**	**REVISION**
MIL08A-L22-SW-SW-DR-E-90204	Underground Electrical System - Sitewide Earthing System Layout - Overview	Civil	P02	PDF	1:250	A0	17.Jan.24	17.Jan.24	P02
MIL08A-L22-SW-SW-DR-E-90205	Underground Electrical System - Sitewide Lighting System Layout - Overview	Civil	P02	PDF	1:250	A0	17.Jan.24	17.Jan.24	P02
MIL08A-L22-SW-SW-DR-E-90206	Underground Electrical System - Sitewide LV System Layout - Overview	Civil	P02	PDF	1:250	A0	17.Jan.24	17.Jan.24	P02
MIL08A-L22-SW-SW-DR-E-90207	Underground Electrical System - Sitewide ELV System Layout - Overview	Civil	P02	PDF	1:250	A0	17.Jan.24	17.Jan.24	P02
MIL08A-L22-SW-SW-DR-E-90208	Underground Electrical System - Sitewide Security System Layout - Overview	Civil	P02	PDF	1:250	A0	17.Jan.24	17.Jan.24	P02
ELECTRICAL - DOCUMENTS									
MIL08A-L22-SW-SW-SP-E-90001	Underground Electrical System - Technical Specifications	Civil	P01	PDF	N/A	A4	07.Feb.24		P01
MIL08A-L22-SW-SW-BQ-E-90001	Underground Electrical System - Price Bill of Quantity	Civil	P01	PDF	N/A	A4	07.Feb.24		P01
MIL08A-L22-SW-SW-BQ-E-90002	Underground Electrical System - Bill of Quantity	Civil	P01	PDF	N/A	A4	07.Feb.24		P01
MIL08A-L22-SW-SW-BQ-E-90003	Underground Electrical System - Priced List	Civil	P01	PDF	N/A	A4	07.Feb.24		P01
MIL08A-L22-SW-SW-RP-E-90001	Underground Electrical System - Technical Report	Civil	P01	PDF	N/A	A4	07.Feb.24		P01
MIL08A-L22-ZZ-XX-SP-E-00001	Electrical and Special System - Technical Specifications	Civil	P01	PDF	N/A	A4	07.Feb.24		P01
MIL08A-L22-ZZ-XX-BQ-E-00001	Electrical and Special System - Price Bill of Quantity	Civil	P01	PDF	N/A	A4	07.Feb.24		P01
MIL08A-L22-ZZ-XX-BQ-E-00002	Electrical and Special System - Bill of Quantity	Civil	P01	PDF	N/A	A4	07.Feb.24		P01
MIL08A-L22-ZZ-XX-BQ-E-00003	Electrical and Special System - Priced List	Civil	P01	PDF	N/A	A4	07.Feb.24		P01
MIL08A-L22-XX-XX-RP-E-00001	Electrical and Special System - Photovoltaic Calculation Report	Civil	P01	PDF	N/A	A4	17.Jan.24	17.Jan.24	P01
ELECTRICAL - CALCULATION									
MIL08A-L22-DC-XX-CA-E-00001	Electrical and Special System - External Lighting Calculation	Civil	P01	PDF	N/A	N/A	17.Jan.24	17.Jan.24	P01
STRUCTURAL - DRAWINGS									
MIL08A-SPS-DC-ZZ-DR-S-20201	Design load plans	Structural	P03	PDF	1:500	A0	17.Jan.24	17.Jan.24	P03
MIL08A-SPS-DC-0F-DR-S-20202	Foundation Plan-Office-Data Hall	Structural	P02	PDF	1:200	A0	17.Jan.24	17.Jan.24	P02
MIL08A-SPS-DC-0G-DR-S-20203	Office Data Hall Level 00 Plan	Structural	P02	PDF	1:200	A0	17.Jan.24	17.Jan.24	P02
MIL08A-SPS-DC-01-DR-S-20204	Office Data Hall Level 01 Plan	Structural	P02	PDF	1:200	A0	17.Jan.24	17.Jan.24	P02
MIL08A-SPS-DC-RF-DR-S-20205	Office Data Hall Roof Level Plan	Structural	P02	PDF	1:200	A0	17.Jan.24	17.Jan.24	P02
MIL08A-SPS-DC-XX-DR-S-20406	Typical Section	Structural	P02	PDF	1:200	A0	17.Jan.24	17.Jan.24	P02
MIL08A-SPS-DC-RF-DR-S-20207	Roof Plan-Steel Structure-Office Data Hall	Structural	P01	PDF	1:200	A0	17.Jan.24	17.Jan.24	P01
MIL08A-SPS-DC-XX-DR-S-20508	Stairs Layuot	Structural	P01	PDF	1:50	A0	17.Jan.24	17.Jan.24	P01
MIL08A-SPS-DC-XX-DR-S-20509	Typical Details	Structural	P01	PDF	1:20-1:50	A0	17.Jan.24	17.Jan.24	P01
MIL08A-SPS-DC-XX-DR-S-20510	Lamination Tank	Structural	P01	PDF	1:100	A0	17.Jan.24	17.Jan.24	P01
STRUCTURAL - DOCUMENTS									
MIL08A-L22-DC-XX-CA-S-00001	Calculation Report	Structural	P01	PDF	N/A	N/A	17.Jan.24	17.Jan.24	P01
MEP									
REGISTERS									
MIL08A-BWE-XX-XX-RG-N-00001	BWE Master Information Delivery Plan (MIDP)	All Discilines	P03	XLS/PDF	N/A	A4	17.Jan.24	17.Jan.24	P03
MODELS									
MIL08A-BWE-DC-ZZ-M3-N-00001	Building A MEP Model	Combined Services - MEP	P02	RVT/NWC	N/A	N/A	17.Jan.24	17.Jan.24	P02
MIL08A-BWE-ZZ-ZZ-CM-Z-00001	Federated Model	Combined Services - MEP	P01	RVT/NWC	N/A	N/A	17.Jan.24	17.Jan.24	P01
MECHANICAL DRAWINGS									
50 Series - Environmental Treatment									
MIL08A-BWE-DC-XX-DR-M-50001	Mechanical Services, General Notes	Mechanical	P01	PDF	NTS	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-XX-DR-M-50501	Mechanical Services, Details	Mechanical	P01	PDF	NTS	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-XX-DR-P-50501	Public Health Services, Details	Mechanical	P01	PDF	NTS	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-XX-DR-F-50501	Fire Protection Services, Details	Mechanical	P01	PDF	NTS	A0	17.Jan.25	17.Jan.25	P01
51Series - BMS/EPMS									
MIL08A-BWE-DC-0G-DR-M-51201	Indicative Sensor Location Layout Level 00 Overview	BMS/EPMS	P03	PDF	1:200	A0	17.Jan.25	17.Jan.25	P03
MIL08A-BWE-DC-0G-DR-M-51202	Indicative Sensor Location Layout Level 00 Sheet 1	BMS/EPMS	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-M-51203	Indicative Sensor Location Layout Level 00 Sheet 2	BMS/EPMS	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-M-51204	Indicative Sensor Location Layout Level 00 Sheet 3	BMS/EPMS	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-M-51205	Indicative Sensor Location Layout Level 00 Sheet 4	BMS/EPMS	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-M-51201	Indicative Sensor Location Layout Roof Level Overview	BMS/EPMS	P01	PDF	1:200	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-M-51202	Indicative Sensor Location Layout Roof Level Sheet 1	BMS/EPMS	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-M-51203	Indicative Sensor Location Layout Roof Level Sheet 2	BMS/EPMS	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-M-51204	Indicative Sensor Location Layout Roof Level Sheet 3	BMS/EPMS	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-M-51205	Indicative Sensor Location Layout Roof Level Sheet 4	BMS/EPMS	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-OF-ZZ-DR-M-51201	Indicative sensor location Layout Admin Block, Multiple Levels	BMS/EPMS	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-ZZ-SC-M-51101	BMS Schematic	BMS/EPMS	P03	PDF	N.T.S	A0	17.Jan.25	17.Jan.25	P03
MIL08A-BWE-DC-ZZ-SC-M-51102	EPMS Schematic	BMS/EPMS	P03	PDF	N.T.S	A0	17.Jan.25	17.Jan.25	P03
MIL08A-BWE-DC-ZZ-SC-M-51103	Leak Detection Schematic	BMS/EPMS	P03	PDF	N.T.S	A0	17.Jan.25	17.Jan.25	P03
MIL08A-BWE-DC-0G-DR-M-51210	Leak Detection Layout Level 00 Overview	BMS/EPMS	P01	PDF	1:200	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-M-51211	Leak Detection Layout Level 00 Sheet 1	BMS/EPMS	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-M-51212	Leak Detection Layout Level 00 Sheet 2	BMS/EPMS	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-M-51213	Leak Detection Layout Level 00 Sheet 3	BMS/EPMS	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-M-51214	Leak Detection Layout Level 00 Sheet 4	BMS/EPMS	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-M-51210	Leak Detection Layout Roof Level Overview	BMS/EPMS	P01	PDF	1:200	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-M-51211	Leak Detection Layout Roof Sheet 1	BMS/EPMS	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-M-51212	Leak Detection Layout Roof Sheet 2	BMS/EPMS	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-M-51213	Leak Detection Layout Roof Sheet 3	BMS/EPMS	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-M-51214	Leak Detection Layout Roof Sheet 4	BMS/EPMS	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-OF-ZZ-DR-M-51210	Leak Detection layout Admin Block, Multiple Levels	BMS/EPMS	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
52 Series - DRAINAGE									
MIL08A-BWE-DC-ZZ-SC-P-52101	Drainage Schematic Sheet 1	Drainage	P02	PDF	N.T.S	A0	17.Jan.25	17.Jan.25	P02
MIL08A-BWE-DC-ZZ-SC-P-52102	Drainage Schematic Sheet 2	Drainage	P01	PDF	N.T.S	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-ZZ-SC-P-52103	Condensate Drain Pipe Schematic	Drainage	P01	PDF	N.T.S	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-P-52210	Drainage Layout Level 00 Overview	Drainage	P01	PDF	1:200	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-P-52211	Drainage Layout Level 00 Sheet 1	Drainage	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-P-52212	Drainage Layout Level 00 Sheet 2	Drainage	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-P-52213	Drainage Layout Level 00 Sheet 3	Drainage	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-P-52214	Drainage Layout Level 00 Sheet 4	Drainage	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-P-52210	Drainage Layout Roof Level Overview	Drainage	P01	PDF	1:200	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-P-52211	Drainage Layout Roof Level Sheet 1	Drainage	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-P-52212	Drainage Layout Roof Level Sheet 2	Drainage	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-P-52213	Drainage Layout Roof Level Sheet 3	Drainage	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-P-52214	Drainage Layout Roof Level Sheet 4	Drainage	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-OF-ZZ-DR-P-52201	Drainage Layout, Admin Block, Multiple levels	Drainage	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
53 Series - DOMESTIC WATER									
MIL08A-BWE-DC-ZZ-SC-P-53101	Water Supply Schematic Sheet 1	Water Supply	P02	PDF	N.T.S	A0	17.Jan.25	17.Jan.25	P02
MIL08A-BWE-DC-0G-SC-P-53102	Water Supply Schematic Sheet 2	Water Supply	P02	PDF	N.T.S.	A0	17.Jan.25	17.Jan.25	P02
MIL08A-BWE-DC-0G-DR-P-53210	Water Supply Layout Level 00 Overview	Water Supply	P01	PDF	1:200	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-P-53211	Water Supply Layout Level 00 Sheet 1	Water Supply	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-P-53212	Water Supply Layout Level 00 Sheet 2	Water Supply	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-P-53213	Water Supply Layout Level 00 Sheet 3	Water Supply	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-P-53214	Water Supply Layout Level 00 Sheet 4	Water Supply	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-P-53210	Water Supply Layout Roof Level Overview	Water Supply	P01	PDF	1:200	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-P-53211	Water Supply Layout Roof Level Sheet 1	Water Supply	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-P-53212	Water Supply Layout Roof Level Sheet 2	Water Supply	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-P-53213	Water Supply Layout Roof Level Sheet 3	Water Supply	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-P-53214	Water Supply Layout Roof Level Sheet 4	Water Supply	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-OF-ZZ-DR-P-53201	Water Supply Layout, Admin Block, Multiple levels	Water Supply	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
54 Series - FUEL									

							STAGE 3		
							100% DEVELOPED DESIGN		
DOCUMENT REFERENCE	**DESCRIPTION**	**DISCIPLINE**	**CURRENT REVSION**	**EXCHANGE FORMATS**	**SCALE**	**SIZE**	**REQUIRED DATE**	**ISSUED DATE**	**REVISION**
MIL08A-BWE-DC-ZZ-SC-M-54101	Typical Fuel Schematic IT & Mech Generators (3000kVA)	Fuel	P03	PDF	N.T.S	A0	17.Jan.25	17.Jan.25	P03
MIL08A-BWE-DC-0G-DR-M-54210	Fuel Layout Level 00 Overview	Fuel	P01	PDF	1:200	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-M-54211	Fuel Layout Level 00 Sheet 1	Fuel	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-M-54212	Fuel Layout Level 00 Sheet 2	Fuel	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-M-54213	Fuel Layout Level 00 Sheet 3	Fuel	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-M-54214	Fuel Layout Level 00 Sheet 4	Fuel	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
55 Series - COOLING				.					
MIL08A-BWE-DC-ZZ-SC-M-55101	Critical Cooling Schematic Sheet 1	Cooling	P03	PDF	N.T.S	A0	17.Jan.25	17.Jan.25	P03
MIL08A-BWE-DC-ZZ-SC-M-55102	Critical Cooling Schematic Sheet 2	Cooling	P03	PDF	N.T.S	A0	17.Jan.25	17.Jan.25	P03
MIL08A-BWE-DC-ZZ-SC-M-55103	Buffer Vessels Mode of Operations	Cooling	P03	PDF	N.T.S	A0	17.Jan.25	17.Jan.25	P03
MIL08A-BWE-ZZ-ZZ-SC-M-55101	Cooling & Heating Schematic	Cooling	P02	PDF	N.T.S	A0	17.Jan.25	17.Jan.25	P02
MIL08A-BWE-DC-0G-DR-M-55201	Critical Cooling Layout Level 00 Overview	Cooling	P03	PDF	1:200	A0	17.Jan.25	17.Jan.25	P03
MIL08A-BWE-DC-0G-DR-M-55202	Critical Cooling Layout Level 00 Sheet 1	Cooling	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-M-55203	Critical Cooling Layout Level 00 Sheet 2	Cooling	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-M-55204	Critical Cooling Layout Level 00 Sheet 3	Cooling	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-M-55205	Critical Cooling Layout Level 00 Sheet 4	Cooling	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-M-55201	Critical Cooling Layout Roof Level Overview	Cooling	P03	PDF	1:200	A0	17.Jan.25	17.Jan.25	P03
MIL08A-BWE-DC-RF-DR-M-55202	Critical Cooling Layout Roof Level Sheet 1	Cooling	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-M-55203	Critical Cooling Layout Roof Level Sheet 2	Cooling	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-M-55204	Critical Cooling Layout Roof Level Sheet 3	Cooling	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-M-55205	Critical Cooling Layout Roof Level Sheet 4	Cooling	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-OF-ZZ-DR-M-55201	Cooling & Heating Layout, Admin Block, Multiple levels	Cooling	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
57 Series - VENTILATION				.					
MIL08A-BWE-DC-ZZ-SC-M-57101	Typical Ventilation Schematic - DH Building	Ventilation	P03	PDF	N.T.S	A0	17.Jan.25	17.Jan.25	P03
MIL08A-BWE-DC-ZZ-SC-M-57102	Typical Ventilation Schematic - Smoke System	Ventilation	P03	PDF	N.T.S	A0	17.Jan.25	17.Jan.25	P03
MIL08A-BWE-OF-ZZ-SC-M-57103	Ventilation Schematic - Admin Block	Ventilation	P02	PDF	N.T.S	A0	17.Jan.25	17.Jan.25	P02
MIL08A-BWE-DC-0G-DR-M-57210	Ventilation Layout Level 00 Overview	Ventilation	P02	PDF	1:200	A0	17.Jan.25	17.Jan.25	P02
MIL08A-BWE-DC-0G-DR-M-57211	Ventilation Layout Level 00 Sheet 1	Ventilation	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-M-57212	Ventilation Layout Level 00 Sheet 2	Ventilation	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-M-57213	Ventilation Layout Level 00 Sheet 3	Ventilation	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-M-57214	Ventilation Layout Level 00 Sheet 4	Ventilation	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-M-57210	Ventilation Layout - Roof Level Overview	Ventilation	P02	PDF	1:200	A0	17.Jan.25	17.Jan.25	P02
MIL08A-BWE-DC-RF-DR-M-57211	Ventilation Layout - Roof Level sheet 1	Ventilation	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-M-57212	Ventilation Layout - Roof Level sheet 2	Ventilation	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-M-57213	Ventilation Layout - Roof Level sheet 3	Ventilation	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-M-57214	Ventilation Layout - Roof Level sheet 4	Ventilation	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-OF-ZZ-DR-M-57201	Ventilation Layout, Admin Block, Multiple levels	Ventilation	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
58 Series - FIRE FIGHTING									
MIL08A-BWE-DC-ZZ-SC-F-58101	Fire Suppression Schematic Sheet 1	Fire Protection	P03	PDF	N.T.S	A0	17.Jan.25	17.Jan.25	P03
MIL08A-BWE-DC-ZZ-SC-F-58102	Fire Suppression Schematic Sheet 2	Fire Protection	P03	PDF	N.T.S	A0	17.Jan.25	17.Jan.25	P03
MIL08A-BWE-DC-0G-DR-F-58801	Fire Protection Zoning Layout - Level 00	Fire Protection	P03	PDF	1:200	A0	17.Jan.25	17.Jan.25	P03
MIL08A-BWE-DC-01-DR-F-58801	Fire Protection Zoning Layout - Level 01	Fire Protection	P03	PDF	1:200	A0	17.Jan.25	17.Jan.25	P03
MIL08A-BWE-DC-RF-DR-F-58801	Fire Protection Zoning Layout - Roof Level	Fire Protection	P03	PDF	1:200	A0	17.Jan.25	17.Jan.25	P03
MIL08A-BWE-DC-0G-DR-F-58210	Fire Protection Layout Level 00 Overview	Fire Protection	P01	PDF	1:200	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-F-58211	Fire Protection Layout Level 00 Sheet 1	Fire Protection	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-F-58212	Fire Protection Layout Level 00 Sheet 2	Fire Protection	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-F-58213	Fire Protection Layout Level 00 Sheet 3	Fire Protection	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-F-58214	Fire Protection Layout Level 00 Sheet 4	Fire Protection	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-F-58210	Fire Protection Layout Roof Level Overview	Fire Protection	P01	PDF	1:200	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-F-58211	Fire Protection Layout Roof Level Sheet 1	Fire Protection	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-F-58212	Fire Protection Layout Roof Level Sheet 2	Fire Protection	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-F-58213	Fire Protection Layout Roof Level Sheet 3	Fire Protection	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-F-58214	Fire Protection Layout Roof Level Sheet 4	Fire Protection	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-OF-ZZ-DR-F-58201	Fire Protection Layout, Admin Block, Multiple levels	Fire Protection	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
ELECTRICAL DRAWINGS									
SERIES 60 - ELECTRICAL GENERAL									
MIL08A-BWE-DC-0G-DR-E-60210	Data Hall Power Striping Layout - Level 00 Overview	Electrical	P03	PDF	1:200	A0	17.Jan.25	17.Jan.25	P03
MIL08A-BWE-DC-ZZ-DR-E-60210	Photovoltaic Panel Layout Overview	Electrical	P02	PDF	1:200	A0	17.Jan.25	17.Jan.25	P02
MIL08A-BWE-DC-ZZ-DR-E-60501	Electrical Details, Sheet 1	Electrical	P01	PDF	N.T.S	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-ZZ-DR-E-60502	Electrical Details, Sheet 2	Electrical	P01	PDF	N.T.S	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-ZZ-DR-E-60503	Typical Mounting Elevation of Electrical Services	Electrical	P01	PDF	N.T.S	A0	17.Jan.25	17.Jan.25	P01
SERIES 61 - MV and LV SLD									
MIL08A-BWE-DC-ZZ-SC-E-61101	MV Schematics Overview	SLD	P03	PDF	N.T.S	A0	17.Jan.25	17.Jan.25	P03
MIL08A-BWE-DC-ZZ-SC-E-61102	LV Schematics - Typical Critical System Overview	SLD	P03	PDF	N.T.S	A0	17.Jan.25	17.Jan.25	P03
MIL08A-BWE-DC-ZZ-SC-E-61103	LV Schematics - Typical Primary Critical System	SLD	P03	PDF	N.T.S	A0	17.Jan.25	17.Jan.25	P03
MIL08A-BWE-DC-ZZ-SC-E-61104	LV Schematics - Typical Reserve Critical System	SLD	P03	PDF	N.T.S	A0	17.Jan.25	17.Jan.25	P03
MIL08A-BWE-DC-ZZ-SC-E-61105	LV Schematics - Typical Mechanical System Overview	SLD	P03	PDF	N.T.S	A0	17.Jan.25	17.Jan.25	P03
MIL08A-BWE-DC-ZZ-SC-E-61106	LV Schematics - Primary Mechanical System V	SLD	P03	PDF	N.T.S	A0	17.Jan.25	17.Jan.25	P03
MIL08A-BWE-DC-ZZ-SC-E-61107	LV Schematics - Primary Mechanical System W	SLD	P03	PDF	N.T.S	A0	17.Jan.25	17.Jan.25	P03
MIL08A-BWE-DC-ZZ-SC-E-61108	LV Schematics - Primary Mechanical System X	SLD	P03	PDF	N.T.S	A0	17.Jan.25	17.Jan.25	P03
MIL08A-BWE-DC-ZZ-SC-E-61109	LV Schematics - Primary Mechanical System Y	SLD	P01	PDF	NTS	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-ZZ-SC-E-61110	LV Schematics - Primary Mechanical System Z	SLD	P01	PDF	NTS	A0	17.Jan.25	17.Jan.25	P01
SERIES 61 - CONTAINMENT									
MIL08A-BWE-DC-0G-DR-E-61210	Containment Layout - Level 00 Overview	Containment	P02	PDF	1:200	A0	17.Jan.25	17.Jan.25	P02
MIL08A-BWE-DC-0G-DR-E-61211	Containment Layout - Level 00, Sheet 1	Containment	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-E-61212	Containment Layout - Level 00, Sheet 2	Containment	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-E-61213	Containment Layout - Level 00, Sheet 3	Containment	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-E-61214	Containment Layout - Level 00, Sheet 4	Containment	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-E-61210	Containment Layout - Roof Level Overview	Containment	P02	PDF	1:200	A0	17.Jan.25	17.Jan.25	P02
MIL08A-BWE-DC-RF-DR-E-61211	Containment Layout - Roof Level, Sheet 1	Containment	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-E-61212	Containment Layout - Roof Level, Sheet 2	Containment	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-E-61213	Containment Layout - Roof Level, Sheet 3	Containment	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-E-61214	Containment Layout - Roof Level, Sheet 4	Containment	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-E-61220	SP & ELV Containment Layout - Level 00 Overview	Containment	P01	PDF	1:200	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-E-61221	SP & ELV Containment Layout - Level 00, Sheet 1	Containment	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-E-61222	SP & ELV Containment Layout - Level 00, Sheet 2	Containment	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-E-61223	SP & ELV Containment Layout - Level 00, Sheet 3	Containment	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-E-61224	SP & ELV Containment Layout - Level 00, Sheet 4	Containment	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-E-61220	SP & ELV Containment Layout - Roof Level Overview	Containment	P01	PDF	1:200	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-E-61221	SP & ELV Containment Layout - Roof Level, Sheet 1	Containment	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-E-61222	SP & ELV Containment Layout - Roof Level, Sheet 2	Containment	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-E-61223	SP & ELV Containment Layout - Roof Level, Sheet 3	Containment	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-E-61224	SP & ELV Containment Layout - Roof Level, Sheet 4	Containment	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-E-61230	Busbar Layout - Level 00 Overview	Containment	P01	PDF	1:200	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-E-61231	Busbar Layout - Level 00, Sheet 1	Containment	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-E-61232	Busbar Layout - Level 00, Sheet 2	Containment	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-E-61233	Busbar Layout - Level 00, Sheet 3	Containment	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-E-61234	Busbar Layout - Level 00, Sheet 4	Containment	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01

							STAGE 3		
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DOCUMENT REFERENCE	**DESCRIPTION**	**DISCIPLINE**	**CURRENT REVSION**	**EXCHANGE FORMATS**	**SCALE**	**SIZE**	**REQUIRED DATE**	**ISSUED DATE**	**REVISION**
MIL08A-BWE-OF-ZZ-DR-E-61201	Containment Layout Admin Block, Multiple levels	Containment	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-OF-ZZ-DR-E-61202	SP & ELV Containment Layout Admin Block, Multiple levels	Containment	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
SERIES 62 - SMALL POWER									
MIL08A-BWE-SW-SW-DR-E-62210	Sitewide Small Power Layout - Overview	Small Power	P02	PDF	1:250	A0	17.Jan.25	17.Jan.25	P02
MIL08A-BWE-DC-0G-DR-E-62801	Small Power Zoning - Level 00 Overview	Small Power	P02	PDF	1:200	A0	17.Jan.25	17.Jan.25	P02
MIL08A-BWE-DC-01-DR-E-62801	Small Power Zoning - Admin Block, Level 01	Small Power	P02	PDF	1:200	A0	17.Jan.25	17.Jan.25	P02
MIL08A-BWE-DC-RF-DR-E-62801	Small Power Zoning - Roof Level Overview	Small Power	P02	PDF	1:200	A0	17.Jan.25	17.Jan.25	P02
MIL08A-BWE-DC-0G-DR-E-62210	Small Power Layout, Level 00, Overview	Small Power	P01	PDF	1:200	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-E-62211	Small Power Layout, Level 00, Sheet 1	Small Power	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-E-62212	Small Power Layout, Level 00, Sheet 2	Small Power	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-E-62213	Small Power Layout, Level 00, Sheet 3	Small Power	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-E-62214	Small Power Layout, Level 00, Sheet 4	Small Power	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-E-62210	Small Power Layout, Roof Level, Overview	Small Power	P01	PDF	1:200	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-E-62211	Small Power Layout, Roof Level, Sheet 1	Small Power	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-E-62212	Small Power Layout, Roof Level, Sheet 2	Small Power	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-E-62213	Small Power Layout, Roof Level, Sheet 3	Small Power	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-E-62214	Small Power Layout, Roof Level, Sheet 4	Small Power	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-OF-ZZ-DR-E-62201	Small Power Layout Admin Block, Multiple levels	Small Power	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
SERIES 63 - LIGHTING									
MIL08A-BWE-DC-ZZ-SC-E-63101	Lighting Control Overview Schematic	Lighting	P02	PDF	N.T.S	A0	17.Jan.25	17.Jan.25	P02
MIL08A-BWE-DC-ZZ-SC-E-63102	Emergency Lighting Schematic	Lighting	P01	PDF	N.T.S	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-E-63210	Lighting Layout, Level 00, Overview	Lighting	P01	PDF	1:200	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-E-63211	Lighting Layout, Level 00, Sheet 1	Lighting	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-E-63212	Lighting Layout, Level 00, Sheet 2	Lighting	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-E-63213	Lighting Layout, Level 00, Sheet 3	Lighting	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-E-63214	Lighting Layout, Level 00, Sheet 4	Lighting	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-E-63210	Lighting Layout, Roof Level, Overview	Lighting	P01	PDF	1:200	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-E-63211	Lighting Layout, Roof Level, Sheet 1	Lighting	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-E-63212	Lighting Layout, Roof Level, Sheet 2	Lighting	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-E-63213	Lighting Layout, Roof Level, Sheet 3	Lighting	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-E-63214	Lighting Layout, Roof Level, Sheet 4	Lighting	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-SW-ZZ-DR-E-63201	Sitewide Lighting Layout, Overview	Lighting	P01	PDF	1:500	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-OF-ZZ-DR-E-63201	Lighting Layout Admin Block, Multiple levels	Lighting	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
SERIES 65 - TELECOMS									
MIL08A-BWE-DC-ZZ-SC-E-65101	Telecoms Schematics	Telecoms	P03	PDF	N.T.S	A0	17.Jan.25	17.Jan.25	P03
MIL08A-BWE-DC-0G-DR-E-65201	Telecoms Pathways Level 00 Overview	Telecoms	P03	PDF	1:200	A0	17.Jan.25	17.Jan.25	P03
MIL08A-BWE-DC-01-DR-E-65201	Telecoms Pathways Level 01 Overview	Telecoms	P03	PDF	1:100	A0	17.Jan.25	17.Jan.25	P03
MIL08A-BWE-DC-ZZ-SC-E-65102	Landlord Network Schematics Sheet 1	Telecoms	P01	PDF	N.T.S	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-ZZ-SC-E-65103	Landlord Network Schematics Sheet 2	Telecoms	P01	PDF	N.T.S	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-E-65210	Data Point Layout Level 00 Overview	Telecoms	P01	PDF	1:200	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-E-65211	Data Point Layout Level 00 Sheet 1	Telecoms	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-E-65212	Data Point Layout Level 00 Sheet 2	Telecoms	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-E-65213	Data Point Layout Level 00 Sheet 3	Telecoms	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-E-65214	Data Point Layout Level 00 Sheet 4	Telecoms	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-E-65210	Data Point Layout Roof Level Overview	Telecoms	P01	PDF	1:200	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-E-65211	Data Point Layout Roof Level Sheet 1	Telecoms	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-E-65212	Data Point Layout Roof Level Sheet 2	Telecoms	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-E-65213	Data Point Layout Roof Level Sheet 3	Telecoms	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-E-65214	Data Point Layout Roof Level Sheet 4	Telecoms	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-OF-ZZ-DR-E-65201	Data Point layout Admin Block, Multiple Levels	Telecoms	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-SW-ZZ-DR-E-65201	Sitewide Data Point Layout, Overview	Telecoms	P01	PDF	1:500	A0	17.Jan.25	17.Jan.25	P01
SERIES 67 - SECURITY									
MIL08A-BWE-DC-ZZ-SC-E-67101	Security Functional Schematic	Security	P03	PDF	N.T.S	A0	17.Jan.25	17.Jan.25	P03
MIL08A-BWE-DC-0G-DR-E-67210	Security Layout Level 00 Overview	Security	P01	PDF	1:200	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-E-67211	Security Layout Level 00 Sheet 1	Security	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-E-67212	Security Layout Level 00 Sheet 2	Security	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-E-67213	Security Layout Level 00 Sheet 3	Security	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-E-67214	Security Layout Level 00 Sheet 4	Security	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-E-67210	Security Layout Roof level Overview	Security	P01	PDF	1:200	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-E-67211	Security Layout Roof level Sheet 1	Security	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-E-67212	Security Layout Roof level Sheet 2	Security	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-E-67213	Security Layout Roof level Sheet 3	Security	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-E-67214	Security Layout Roof level Sheet 4	Security	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-OF-ZZ-DR-E-67201	Security Layout Admin Block, Multiple Levels	Security	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-SW-ZZ-DR-E-67201	Sitewide Security Layout, Overview	Security	P01	PDF	1:500	A0	17.Jan.25	17.Jan.25	P01
SERIES 68 - FIRE ALARM									
MIL08A-BWE-DC-ZZ-SC-E-68101	Typical Fire Alarm Schematic	Fire Alarm	P03	PDF	1:200	A0	17.Jan.25	17.Jan.25	P03
MIL08A-BWE-DC-0G-DR-E-68801	Fire Alarm Zoning Level 00 Overview	Fire Alarm	P03	PDF	1:250	A0	17.Jan.25	17.Jan.25	P03
MIL08A-BWE-DC-0G-DR-E-68210	Fire Alarm Layout Level 00 Overview	Fire Alarm	P01	PDF	1:200	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-E-68211	Fire Alarm Layout Level 00 Sheet 1	Fire Alarm	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-E-68212	Fire Alarm Layout Level 00 Sheet 2	Fire Alarm	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-E-68213	Fire Alarm Layout Level 00 Sheet 3	Fire Alarm	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-E-68214	Fire Alarm Layout Level 00 Sheet 4	Fire Alarm	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-E-68220	Fire Alarm Ceiling Void Layout Level 00 Overview	Fire Alarm	P01	PDF	1:200	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-E-68221	Fire Alarm Ceiling Void Layout Level 00 Sheet 1	Fire Alarm	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-E-68222	Fire Alarm Ceiling Void Layout Level 00 Sheet 2	Fire Alarm	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-E-68223	Fire Alarm Ceiling Void Layout Level 00 Sheet 3	Fire Alarm	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-E-68224	Fire Alarm Ceiling Void Layout Level 00 Sheet 4	Fire Alarm	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-01-DR-E-6881	Fire Alarm Zoning Admin Block, Level 01	Fire Alarm	P03	PDF	1:250	A0	17.Jan.25	17.Jan.25	P03
MIL08A-BWE-DC-RF-DR-E-6881	Fire Alarm Zoning Roof Level Overview	Fire Alarm	P03	PDF	1:200	A0	17.Jan.25	17.Jan.25	P03
MIL08A-BWE-DC-RF-DR-E-68210	Fire Alarm Layout Roof Level Overview	Fire Alarm	P01	PDF	1:200	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-E-68211	Fire Alarm Layout Roof Level Sheet 1	Fire Alarm	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-E-68212	Fire Alarm Layout Roof Level Sheet 2	Fire Alarm	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-E-68213	Fire Alarm Layout Roof Level Sheet 3	Fire Alarm	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-E-68214	Fire Alarm Layout Roof Level Sheet 4	Fire Alarm	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-OF-ZZ-DR-E-68201	Fire Alarm Layout Admin Block, Multiple Levels	Fire Alarm	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-OF-ZZ-DR-E-68202	Fire Alarm Void Detectors Layout Admin Block, Multiple Levels	Fire Alarm	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-SW-ZZ-DR-E-68201	Sitewide Fire Alarm Layout, Overview	Fire Alarm	P01	PDF	1:500	A0	17.Jan.25	17.Jan.25	P01
SERIES 69 - EARTHING & LIGHTNING PROTECTION									
MIL08A-BWE-DC-ZZ-SC-E-69101	Earthing Schematic Sheet 1	Earthing & Lightning	P01	PDF	NTS	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-ZZ-SC-E-69102	Earthing Schematic Sheet 2	Earthing & Lightning	P01	PDF	NTS	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-ZZ-SC-E-69103	Telecoms Earthing Schematic	Earthing & Lightning	P01	PDF	NTS	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-E-69210	Earthing & Lightning Protection Layout, Level 00, Overview	Earthing & Lightning	P01	PDF	1:200	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-E-69210	Earthing & Lightning Protection Layout, Roof Level, Overview	Earthing & Lightning	P01	PDF	1:200	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-OF-01-DR-E-69201	Earthing & Lightning Protection, Admin Block, Level 01	Earthing & Lightning	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-SW-ZZ-DR-E-69210	Sitewide Earthing & Lightning Protection Layout, Overview	Earthing & Lightning	P01	PDF	1:200	A0	17.Jan.25	17.Jan.25	P01
COMBINED MEP DRAWINGS									
MIL08A-BWE-DC-0G-DR-N-70201	MEP Primary Plant Layout Level 00 Overview	Combined Services - MEP	P03	PDF	1:200	A0	17.Jan.25	17.Jan.25	P03

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MIL08A-BWE-OF-1-DR-N-70201	MEP Primary Plant Layout, Admin Block, Level 01	Combined Services - MEP	P01	PDF	1:100	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-RF-DR-N-70201	MEP Primary Plant Layout Roof Level Overview	Combined Services - MEP	P03	PDF	1:500	A0	17.Jan.25	17.Jan.25	P03
MIL08A-BWE-FR-0G-DR-N-70201	Fire Protection Tank & Pump Room Layout	Combined Services - MEP	P01	PDF	1:50	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-ZZ-DR-N-70601	Typical 6MW Data Hall Layout	Combined Services - MEP	P03	PDF	1:100	A0	17.Jan.25	17.Jan.25	P03
MIL08A-BWE-DC-ZZ-DR-N-7062	Typical 4MW Data Hall Layout	Combined Services - MEP	P03	PDF	1:50	A0	17.Jan.25	17.Jan.25	P03
MIL08A-BWE-DC-ZZ-DR-N-7033	Typical Switchroom Layout	Combined Services - MEP	P03	PDF	1:50	A0	17.Jan.25	17.Jan.25	P03
MIL08A-BWE-DC-ZZ-DR-N-7034	Typical MMR & ER Room Layout	Combined Services - MEP	P03	PDF	1:50	A0	17.Jan.25	17.Jan.25	P03
MIL08A-BWE-SW-ZZ-DR-N-70301	MEP Services Layout, External Rooms	Combined Services - MEP	P01	PDF	1:50	A0	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-DC-0G-DR-N-70801	Plant Replacement Layout, Level 00	Combined Services - MEP	P02	PDF	1:200	A0	17.Jan.25	17.Jan.25	P02
MIL08A-BWE-DC-RF-DR-N-70801	Plant Replacement Layout, Roof Level	Combined Services - MEP	P02	PDF	1:200	A0	17.Jan.25	17.Jan.25	P02
MIL08A-BWE-DC-0G-DR-N-70802	MEP Phasing Layout, Level 00	Combined Services - MEP	P02	PDF	1:200	A0	17.Jan.25	17.Jan.25	P02
MIL08A-BWE-OF-1-DR-N-70802	MEP Phasing Layout, Admin Block, Level 01	Combined Services - MEP	P02	PDF	1:200	A0	17.Jan.25	17.Jan.25	P02
MIL08A-BWE-DC-RF-DR-N-70802	MEP Phasing Layout, Roof Level	Combined Services - MEP	P02	PDF	1:200	A0	17.Jan.25	17.Jan.25	P02
MIL08A-BWE-DC-ZZ-DR-N-70401	MEP Services , Typical Sections	Combined Services - MEP	P01	PDF	NTS	A0	17.Jan.25	17.Jan.25	P01
MEP DOCUMENTS									
CALCULATIONS									
MIL08A-BWE-XX-XX-CA-M-00001	Mechanical Calculations	Mechanical	P02	PDF	N/A	N/A	17.Jan.25	17.Jan.25	P02
MIL08A-BWE-XX-XX-CA-M-00003	Preliminary CHW Pump Head Calculation	Mechanical	P01	PDF	N/A	N/A	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-XX-XX-CA-E-00001	Electrical Calculations	Electrical	P02	PDF	N/A	N/A	17.Jan.25	17.Jan.25	P02
MIL08A-BWE-XX-XX-CA-E-63001	Lighting Calculations	Electrical	P01	PDF	N/A	N/A	17.Jan.25	17.Jan.25	P01
REPORTS									
MIL08A-BWE-XX-XX-RP-F-00001	Fire Alarm Cause and Effect Matrix	Fire Alarm	P02	PDF	N/A	N/A	17.Jan.25	17.Jan.25	P02
MIL08A-BWE-XX-XX-RP-M-00001	Preliminary External CFD Report	Mechanical	P01	PDF	N/A	N/A	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-XX-XX-RP-M-00002	Preliminary Internal CFD Report	Mechanical	P01	PDF	N/A	N/A	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-XX-XX-RP-E-60001	Electrical SOO	Electrical	P01	PDF	N/A	N/A	17.Jan.25	17.Jan.25	P01
MIL04D-BWE-XX-XX-RP-E-69001	Lightning Protection Risk Assessment Report	Electrical	P01	PDF	N/A	N/A	17.Jan.25	17.Jan.25	P01
SCHEDULES									
MIL08A-BWE-SW-XX-SH-M-51701	BACS Points List	Mechanical	P02	PDF	N/A	N/A	17.Jan.25	17.Jan.25	P02
MIL08A-BWE-SW-XX-SH-M-50702	Mechanical Equipment Schedule	Mechanical	P01	PDF	N/A	N/A	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-XX-XX-SH-M-51703	BMS Specifications	Mechanical	P01	PDF	N/A	N/A	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-XX-XX-SH-M-58704	Fire Water Tank Data Sheet	Mechanical	P01	PDF	N/A	N/A	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-SW-XX-SH-E-60701	Luminaire Schedule	Electrical	P01	PDF	N/A	N/A	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-SW-XX-SH-E-60702	Cable Schedule	Electrical	P01	PDF	N/A	N/A	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-SW-XX-SH-E-60703	Electrical Distribution Boards Summary	Electrical	P01	PDF	N/A	N/A	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-SW-XX-SH-E-67704	Camera Schedule	Electrical	P01	PDF	N/A	N/A	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-SW-XX-SH-E-60705	EPO Matrix	Electrical	P01	PDF	N/A	N/A	17.Jan.25	17.Jan.25	P01
SPECIFICATIONS									
MIL08A-BWE-XX-XX-SP-M-50001	OFCI Specifications - Air Cooled Chillers	Mechanical	P01	PDF	N/A	N/A	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-XX-XX-SP-M-50002	OFCI Specifications - Fan Wall Units	Mechanical	P01	PDF	N/A	N/A	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-XX-XX-SP-M-50003	OFCI Specifications - Cooling Distribution Units	Mechanical	P01	PDF	N/A	N/A	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-XX-XX-SP-E-60001	OFCI Specifications - Power Modules	Electrical	P01	PDF	N/A	N/A	17.Jan.25	17.Jan.25	P01
MIL08A-BWE-XX-XX-SP-E-60002	OFCI Specifications - Generators	Electrical	P01	PDF	N/A	N/A	17.Jan.25	17.Jan.25	P01

APPENDIX B – CUSTOMER SOQ MATRIX

01 The Project shall comply with the Customer Liquid to Liquid Requirements. The technical requirements have been included in this Appendix for reference.

02 The Contractor shall be responsible to provide any necessary documentation to demonstrate compliance with the Customer requirements, including but not limited to what's highlighted below or within the Design Deliverables Index provided by Stack. These lists outline what would be the typical documentation requested; however the Customer may require additional documentation which shall also be provided by the Contractor.

03 Documents:

1. Basis of Design Report for all disciplines covering design criteria and system narratives
2. Electrical Sequence of Operations
3. Mechanical Sequence of Operations
4. Cooling Calculations
5. Buffer vessel transient calculations/CFD
6. Fire suppression calculations
7. Ventilation calculations
8. Fuel Calculations
9. Electrical load schedules
10. PUE Calculations (Peak & Annualised)
11. Fault Current Calculations
12. UPS Battery Backup Calculations
13. BMS point List
14. Cause & Effect Matrix
15. Security Gap Analysis
16. Soil Liquification
17. Site Flood Risk
18. EMF

04 Data Sheets

1. Critical Cooling Data Sheets (Chillers, FWs, CDUs, CRAH…etc)
2. Critical Ventilation Data Sheets
3. Critical Electrical Data Sheets (Generators, RMUs, Transformers, UPS, Power Modules, STS…etc)
4. Busbar and tap-off cutsheets
5. Utility Power Meter data sheets
6. Busbar Row Level Power Meter data sheet
7. Fire detection and suppression data sheets

05 MEP Drawings:

1. Internal Telecom pathways
2. Telecom Schematics
3. Cooling Layouts
4. Cooling Schematics
5. Fuel Layouts
6. Fuel Schematics
7. Fire Suppression Zoning layouts
8. Fire Suppression layouts
9. Fire Suppression Schematics
10. Fire Detection Zoning Layouts
11. Fire detection layouts
12. Fire detection schematics
13. BMS sensor layouts
14. BMS Schematics & Architecture

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15. Leak detection layouts
16. Leak Detection Schematics
17. Containment Layouts
18. MV & LV SLDs
19. Data Hall Dimensional layouts
20. Data Hall Section
21. Power Striping Layouts
22. EPMS Schematics
23. MMR & Entry Room Layouts
24. Security Layouts
25. Security Schematics

06 CSA Drawings:

1. Customer spaces layout – IDF
2. Customer spaces layout - Entrance Room
3. Data hall layout and section
4. Rack and personnel path
5. Customer spaces layout – Premises
6. Customer spaces layout – Offices
7. Customer spaces layout – Storages
8. Customer spaces layout – Parking
9. General Plan and site total area
10. Structure Design load plans
11. Fire & Life Safety Layouts
12. Sitewide fibre / electrical

07 The SOQ matrix shown below is indicative only and does not represent the latest requirement or latest response which will be subject to further updates and development upon further interface with the Customer.

08 All requirements shall be complied with unless otherwise indicated due to being unapplicable to the project or as per Stack's direction.

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Req Id	Disc Section	Disc Subsection	Requirement	Landlord Response	Landlord Comment
2.1.1.1	DCE Mechanical Engineering (ME)	Row Cooling Split - ratio of IT power/cooling load between liquid-cooled and air-cooled IT equipment per row	Provide cooling infrastructure for each row sized for up to a 95% liquid-cooling proportion and approximately 44% air-cooling proportion, based on the design maximum row IT power.	Comply	
2.1.2.1	DCE Mechanical Engineering (ME)	DC Cooling Capacity	At the row level liquid and air cooling capacity is overprovisioned to provide some deployment flexibility, however, at the cooling plant, capacity shall be designed to service 100% of design IT power, when operating N equipment.	Comply	
2.1.3.1	DCE Mechanical Engineering (ME)	Facility Water (cooling) Distribution	Liquid cooled equipment will be isolated from the facility water loop via a Cooling Distribution Unit (CDU). The LP is required to provide the facility water supply and return to the primary side of the CDU. For 5x9s loads only - chilled water pumps serving liquid cooling loads shall be UPS backed.	Comply	
2.1.4.1	DCE Mechanical Engineering (ME)	Technology Water Distribution	The LP is required to provide piping from the secondary side of the CDU to the IT rack positions. Technology water supply shall not exceed 26 degrees C (78.8 degrees F) to the IT equipment inlet. Technology water piping includes connections to the CDU, isolation valves at each row, supply and return headers, and supply and return branches to each rack position with rigid 2" pipe stubs for both the supply and return, isolation valves, pressure independent flow limiting valves (on return only), and sanitary flanges sized to 2in for 1.5 liter/min/kW. The design flowrate of 1.5liter/min/kW shall be maintained at all times. Lease provider shall add air separators into each technology water system. Liquid Delta-T across IT equipment shall be 18°F (10°C). Liquid Delta-P across the IT equipment is 15psi.	Comply	
2.1.5.1	DCE Mechanical Engineering (ME)	CDU Requirements - 5x9s	CDUs are provided to support the liquid cooling proportion of maximum row IT power. The unit shall provide a maximum 10.8°F (6°C) approach temperature delta from the primary facility water system, and a flow rate of 1.5lpm/kW on the CDU secondary side. The delta T on the secondary side of the CDU will be 18°F (10°C). The CDUs shall be provided at N+1 redundancy. Configure CDUs such that the technology water system they serve does not span more than 10 rack rows. CDUs shall be UPS backed.	Comply	
2.1.7.1	DCE Mechanical Engineering (ME)	Water Quality	LP provided facility water system shall be a closed-loop system, filtered per ASHRAE recommendations. Technology water shall be filtered to 25 micron or better, system will contain a mixture of water and 25% propylene glycol.	Comply	
2.1.8.1	DCE Mechanical Engineering (ME)	Freeze Protection	Provide a freeze protection strategy for any facility water loop piping located where there is potential exposure to freezing temperatures.	Comply	
2.1.9.1	DCE Mechanical Engineering (ME)	Thermal Energy Storage (TES) - 5x9s	For 5-9s liquid cooling loads - upon loss of utility power or failure of chiller plant, facility water design flow and temperature shall be maintained via UPS backed pumps and TES. TES ride through shall sustain the load through two consecutive chiller restart cycles, and until 100% of the plant cooling capacity has been restored.	Comply	
2.1.11.1	DCE Mechanical Engineering (ME)	Facility Water Supply Temperature	Provide facility water temperature and flow rate to suit requirements of CDU and the loads.	Comply	
2.1.12.1	DCE Mechanical Engineering (ME)	Air Inlet Temperature at Server and Networking Equipment	50°F to 95°F (10°C to 35°C). Maximum rate of change is 18°F (10°C) per hour. Allowable derating guideline of 1.6°F/1000 feet above 3000 feet (1°C/300m above 1000m).	Comply	
2.1.13.1	DCE Mechanical Engineering (ME)	Inlet Relative Humidity at Server and Networking Equipment	5% to 80% RH, non-condensing. Maximum Rate of Change is 20% RH per hour.	Comply	
2.1.14.1	DCE Mechanical Engineering (ME)	Inlet Temperature at Tape Library	16-25 C (60.8-77F) Maximum temperature rate of change 9°F (5°C) per hour. Only applicable to space where the racks are located	Not applicable	Our understanding is tape library is not applicable to this project
2.1.15.1	DCE Mechanical Engineering (ME)	Inlet Relative Humidity at Tape Libraries	20-50% (Maximum rate of change 5% RH/hour with no condensation). Only applicable to space where the racks are located	Not applicable	Our understanding is tape library is not applicable to this project
2.1.16.1	DCE Mechanical Engineering (ME)	Minimum Airflow for IT Equipment	Minimum airflow of 126 CFM (59.5 L/s) for every kW of air cooled server capacity deployed (based on a 25°F ΔT or about 13.9°C ΔT) must be provided, when the mechanical system is at "N" during failure or maintenance.	Comply	

Req Id	Disc Section	Disc Subsection	Requirement	Landlord Response	Landlord Comment
2.1.17.1	DCE Mechanical Engineering (ME)	Rack Cooling Density	The Colo will consist of a mixture of air-cooled and liquid (hybrid air/liquid) cooled racks. The air cooling proportion (kW) per liquid cooled rack will not exceed 25% of the total rack IT power. Max liquid cooled IT power is 130kW. Air Cooled Racks have a maximum rack density of 46kW/rack.	Comply	
2.1.18.1	DCE Mechanical Engineering (ME)	Containment	Hot aisle containment shall be provided within the Colo	Comply	
2.1.19.1	DCE Mechanical Engineering (ME)	Maintenance	Mechanical infrastructure is 100% concurrently maintainable with no impact or interruption to IT production. The Technology Water Distribution piping is not required to be concurrently maintainable	Comply	
2.1.20.1	DCE Mechanical Engineering (ME)	Cooling Equipment for Server, Networking Equipment	Cooling equipment shall be fault tolerant or concurrently maintainable. System design does not have to accommodate equipment failure occurring during planned maintenance.	Comply	
2.1.21.1	DCE Mechanical Engineering (ME)	Water Supply and Storage	If water consumed is used for cooling (i.e. evaporatively), the water supply to the facility shall have at least 2 incoming piping connections that is served by a gridded water reticulation network with a redundant pumping station operated by the water utility company. If there is only a single piping connection to the facility, Landlord must provide onsite water storage capacity of 48 hours.	Not applicable	Critical cooling via air cooled chillers
2.1.22.1	DCE Mechanical Engineering (ME)	Fuel Oil Supply and Storage - 5x9s	If a fuel oil distribution system is provided, the installation pipework to the Generators or day tanks must be fully looped to allow the isolation of any part of the system without interruption of the supply of diesel fuel to the Generators for 5-9's loads. The installation shall ensure that the diesel fuel distribution pipework is always available and concurrently maintainable.	Not applicable	Individual tank is provided per each Generator
2.1.22.2	DCE Mechanical Engineering (ME)	Fuel Oil Supply and Storage - 5x9s	Landlord must provide on-site diesel fuel storage capacity of at least 48 hours at generator full load.	Comply	
2.1.24.1	DCE Mechanical Engineering (ME)	Electrical Room Environment	50°F to 95°F (10°C to 35°C), 80% RH maximum, non-condensing. For 3-9s server loads, UPS is not required.	Comply	3-9s server loads not applicable to this project
2.1.25.1	DCE Mechanical Engineering (ME)	Battery Room Environment	Batteries should be located in a space with temperature setpoints per the manufacturer recommendation. Typically, 77°F (25°C).	Comply	
2.1.26.1	DCE Mechanical Engineering (ME)	Service Areas including Corridors and Storage	50°F to 95°F (10°C to 35°C), no humidity requirement but must be non-condensing	Comply	
2.1.27.1	DCE Mechanical Engineering (ME)	Admin and Office Environment	68°F to 74°F (20°C to 23°C), 20% to 70% RH, non-condensing. This includes any permanent space where there are tenant desks or workstations setup.	Comply	
2.2.1.1	DCE Fire Protection System	Data Hall	Double interlock pre-action sprinkler system or gaseous suppression with very early warning smoke detection (VESDA or equivalent). Activation of the pre-action sprinkler system or gaseous suppression shall be in automatic mode at all times.	Comply	
2.2.2.1	DCE Fire Protection System	Security Equipment Room	Double interlock pre-action sprinkler system or gaseous suppression with smoke and heat detectors. Activation of the pre-action sprinkler system or gaseous suppression shall be in automatic mode at all times.	Comply	
2.2.3.1	DCE Fire Protection System	Noise Suppression Kit for Nozzle Used in Gaseous Suppression	Noise suppression kit shall be installed on the nozzles of the gaseous suppression system to reduce the sound pressure level when the gas is discharged so that it will not cause damage to hard disk drives inside the servers and data storage systems.	Not applicable	Gaseous suppression system is not utilised on this site
2.2.4.1	DCE Fire Protection System	Electrical Equipment Room	Double interlock pre-action sprinkler system or gaseous suppression with a very early warning smoke detection system (VESDA or equivalent). Activation of the pre-action sprinkler system or gaseous suppression shall be in automatic mode at all times.	Comply	
2.2.5.1	DCE Fire Protection System	Generator room or enclosure	Dry pipe sprinkler system with heat detection	Deviation	Generator enclosures are protected via double interlock preaction sprinkler system with heat detection
2.2.6.1	DCE Fire Protection System	Unit substation enclosure	Double interlock pre-action sprinkler system	Comply	
2.2.7.1	DCE Fire Protection System	Admin and facility operation spaces (corridors, touch down spaces)	Wet sprinkler system	Comply	

Req Id	Disc Section	Disc Subsection	Requirement	Landlord Response	Landlord Comment
2.2.8.1	DCE Fire Protection System	Fire Detection	Smoke Detection Systems shall be installed into the Premises which will be connected to the facility BMS and Fire Alarm and Detection System (FAS). The system shall be provided with both audible and visual alarms for fire annunciation in any space the tenant has permanent access, including but not limited to storage, corridors, restrooms, etc. Installation of visual alarm to be in line with local regulation / code of practice ensuring absence of blind spots. Every HAC and corridor must be provided with a visual alarm and link back to the FAS.	Comply	
2.2.8.2	DCE Fire Protection System	Fire Detection	Fire alarm and fire protection equipment power supply shall be backed up with generator or battery supply for continuous operation during power outage	Comply	
2.2.8.3	DCE Fire Protection System	Fire Detection	Fire alarm activation within the Premises shall not be interlocked to shut down any cooling equipment serving critical loads.	Comply	
2.3.1.1	DCE Building Automation, Monitoring & Control (BAMC)	Mechanical and Environmental Monitoring	No wireless communication protocols of any kind shall be used in the Mechanical / Environmental monitoring systems without specific Tenant approval.	Comply	
2.3.2.1	DCE Building Automation, Monitoring & Control (BAMC)	Leak Detection	Controls scope shall include dedicated leak detection for each rack row. Leak detection sensor shall be rope style, installed on the floor within the row- and HAC- perimeter leak containment.	Comply	
2.3.3.1	DCE Building Automation, Monitoring & Control (BAMC)	Fail Safe	The Building Automation System shall be fail safe and the Sequences of Operation (SOO) shall ensure that no automated action or lack thereof, will bring the mechanical cooling system below the "N" capacity requirement. SOOs shall be coordinated with other automation systems (OEM PLCs, EPMS, FOCP, etc.) to ensure they do not unintentionally effect this redundancy.	Comply	
2.4.1.1	DCE Electrical Engineering (EE)	Electrical Availability Required - 5x9s	Provide 5-9's availability solution for all network racks, which provides a concurrently maintainable, dual corded power solution with UPS and generator backup. Provide electrical infrastructure solution for server racks: A 5-9's solution that provides a concurrently maintainable, dual corded power solution with UPS, and generator backup. Additional requirements for infrastructure based on required availability is provided throughout this document. Only requirements that match the requested availability shall apply to the infrastructure design.	Comply	
2.4.3.1	DCE Electrical Engineering (EE)	Utility Electrical Service and Distribution to Site	Redundant source site utility power is required. This shall originate from diverse utility electrical sources. Power supply from separate substation preferred but separate segregated transformers within the same utility substation is also acceptable. Each source to be capable of supporting 100% of the sites building loads. If the redundant source is not currently available, please confirm if there are plans to upgrade the existing utility supply into dual utility connection at a later date. If the facility is fed by a single utility source (either with single or multiple circuits), utility side availability information shall be provided for the past 5 years which includes MTBF and MTTR of the incoming power connection or Availability and Reliability of incoming power connection from the utility in the region.	Comply	
2.4.4.1	DCE Electrical Engineering (EE)	Site Medium Voltage Distribution to Data Center	Medium voltage distribution / source shall be in redundant / ring configuration to the medium voltage transformers. Each of the redundant source / systems shall be capable of supporting 100% of the data center load.	Comply	
2.4.5.1	DCE Electrical Engineering (EE)	Standby Generator Redundancy - 5x9s	Provide N+1 redundant generators for the network equipment and servers requiring 5-9's availability & their associated mechanical loads. If the generators are parallel connected, there shall be redundant paralleling boards to allow concurrent maintainability. Either open or closed transition between the utility and generators are acceptable.	Comply	

Req Id	Disc Section	Disc Subsection	Requirement	Landlord Response	Landlord Comment
2.4.7.1	DCE Electrical Engineering (EE)	Uninterruptible Power Supply (UPS) Redundancy	The UPS system shall be one of the following configuration as per IEEE Std. 3006.7-2013: - 2N or 2 (N+1) redundant system; - N+1 block redundant (BR) system with static switches and a catcher reserve UPS system; - N+1 distributed redundant (DR) system (2 out of 3 or 3 out of 4 system) Provide UPS capacity for server racks where required, facility water distribution, cooling distribution units (CDUs), and critical monitoring.	Comply	
2.4.8.1	DCE Electrical Engineering (EE)	Power Distribution Units / Rack Power Panels / Distribution Panels / Above Rack Busduct - 5x9s	Provide dedicated Power Distribution Units or Rack Power Panels inclusive of all necessary breakers to support the tenant's electrical distribution to racks. The PDUs / RPPs shall be in 2N (A&B) configuration with diverse routes and location. The Busway / Whips connecting to an individual row of racks shall not be fed from more than a pair of RPPs/ PDUs. All 5x9 racks shall be powered via a 2N (A&B) configuration with diverse routes and location.	Deviation	Power to Tenant racks will be via overhead busbars without PDUs or RPPs. Busbars will be supplied from critical STSs in a block redundant arrangement to ensure continuous supplies to the tenant racks.
2.4.10.1	DCE Electrical Engineering (EE)	Isolation / Server / Load Transformers	The PDUs shall incorporate a server load transformer with K4 harmonic rated as a minimum. The server load transformer shall be with higher impedance to limit the fault current at racks to less than 10 kA or to limit the fault current at PDU secondary to be 13kA (if demarcation is at PDU output breaker). The neutral to earth voltage at racks shall be limited to maximum of 5V.	Deviation	No PDUs provided. Current will be limited to less than 10kA at customer rack level by using inherent limiting of fault current that will be provided by the protective devices
2.4.11.1	DCE Electrical Engineering (EE)	Electrical Reliability of Design - 5x9s	IEEE based MTBF/MTTR calculated inherent availability of 99.999% with a probability of failure of less than 5% in a five-year period to dual corded servers and inherent availability of 99.9% with a probability of failure of less than 70% in a five year period to single corded servers. A calculation and report for the inherent availability of the electrical system shall be provided to validate the design compliance to 5-9 availability requirements if any of the below conditions occur: 1) The facility is fed by single u⍰lity source (either with single or multiple circuits), as an interim or permanent plan. Also utility side availability information shall be provided for past 5 year which includes MTBF and MTTR of the incoming power connection or Availability and Reliability of incoming power connection, at the incoming power service level in the region. 2) The system design redundancy exceeds 6+1 block redundant or 4+1 distributed redundant. 3) The electrical distribution is not concurrent maintainable.	Comply	
2.4.13.1	DCE Electrical Engineering (EE)	Distribution Redundancy	System shall be designed to limit the electrical failure zone to a maximum of a single generator's load. If N+1 redundancy is provided it shall be with a maximum of 6 to 1 redundancy ratio (UPS and Generator). Electrical power supplies to mechanical equipment, building controls, fire alarm systems, etc. shall have same redundancy as other electrical systems (N+1 as minimum) so that a component/ feeder failure does not affect the operation of the system / capacity.	Comply	
2.4.14.0	DCE Electrical Engineering (EE)	Concurrent Maintainability - 5x9s	System shall be 100% concurrently maintainable at every bus with dual corded servers using dual power supplies to allow for maintenance of the final connection points.	Comply	
2.4.16.1	DCE Electrical Engineering (EE)	Power Quality	Server power quality must remain within the IEC 61000, EN 55035 and ITIC computer power tolerance curve. Frequency must remain within +/-5% of nominal frequency. Harmonic voltage distortion must remain below 5% THD peak under steady state conditions. Power factor of servers will range from 0.95 lagging to 0.95 leading at full load operation.	Comply	

Req Id	Disc Section	Disc Subsection	Requirement	Landlord Response	Landlord Comment
2.4.17.1	DCE Electrical Engineering (EE)	Maximum Rack Load	A mix of lower density network racks and higher density server racks will be utilized. Lower density rack power cords shall be individually capable of supporting 17.2kW of load at 240/415V, via 30/32 Amp circuits. Higher density server racks will vary between 34kW-130kW per rack and shall require 240/415V, via 30/32 and/or 60/63 Amp circuits, to be coordinated with tenant. Racks may be configured with single or multiple power cords. Power cords supporting each side of a rack should be fed from the same electrical line-up. The final tap box rating will be determined when the final rack deployment is known. Size and quantity of tap boxes shall be coordinated with tenant.	Comply	
2.4.18.1	DCE Electrical Engineering (EE)	Rack Row	Minimum 24 tiles/rack spaces (22 IT racks tiles/spaces and 2 network tiles/spaces) per row	Comply	
2.4.19.1	DCE Electrical Engineering (EE)	Colo Number of Rows per MW Ratio	For space planning purposes provide a layout based on an average row density of 500kW	Comply	
2.4.20.1	DCE Electrical Engineering (EE)	Row Power Distribution	The power distribution design for the Colo shall be able to accommodate a total power of 680kW/row. Tenant will manage rack deployments so as not to exceed total row and Colo power capacity.	Deviation	The electrical infrastructure can accommodate 680kW rows. However, the number of 680kW rows is limited to the IT capacity of the data hall. Every row cannot have a load of 680kW simultaneously.
2.4.21.1	DCE Electrical Engineering (EE)	IT power to the Servers - 5x9s	For the 5-9's solution, server power supplies will be arranged in an A&B configuration with 2N redundant, diverse paths. Power circuits shall be 240/415V-30A or 240/415V-60A with 80% continuous current derating. All circuits shall be provided as 3 phase, Neutral, and Ground, using IEC 60309 sockets.	Comply	
2.4.23.1	DCE Electrical Engineering (EE)	IT Power Distribution Within the Colo	The Power Supply to the IT Racks shall be provided with RPPs (Remote Power Panel) or with above rack busways. If RPPs are proposed, the RPPs shall be sized to accommodate the total peak power capacity and with sufficient number of circuit breakers to feed the number of racks in the row(s) it is designated to. Each outgoing breaker shall be sized based on requirements contained elsewhere. These circuit breakers shall be coordinated for the discrimination with upstream breakers. If above rack busway is proposed, busway shall be sized to accommodate the total peak power capacity of the row(s) it is designated to. The busway shall be provided with a sufficient number of bus plugs to feed each rack in the row. Bus plug circuit breakers or fuses shall be coordinated for the discrimination with upstream circuit breakers. Busway will be provided as part of the lessor's initial construction and delivered to tenant as Ready for Service.	Comply	
2.4.24.1	DCE Electrical Engineering (EE)	EMF Compliance	The Data Center building shall comply to the limit of magnetic field exposure from any external high power transmission lines to 1.25 µT (Micro Tesla) per EN 55024/IEC61000 to protect IT equipment. If there are any high voltage overhead transmission lines with voltage of 110kV and above within 200m of the Microsoft leased Data Hall area, an EMF study shall be conducted to prove compliance to this requirement. The study shall prove the magnetic field exposure values are less than 1.25uT or there are mitigation measures taken to reduce it to below 1.25uT. The sample points shall be taken at edges of the nearest Data Hall of interest closest to the overhead transmission line and use the nominal current for measurement. Only one EMF study is required for the building.	Comply	
2.5.1.1	DCE Civil, Structural & Architectural (CSA)	Civil	Building is outside of the soil liquefaction zone.	Comply	
2.5.1.2	DCE Civil, Structural & Architectural (CSA)	Civil	Finish Floor Elevation shall be above 100 and 500-year floodplain	Comply	

Req Id	Disc Section	Disc Subsection	Requirement	Landlord Response	Landlord Comment
2.5.2.1	DCE Civil, Structural & Architectural (CSA)	Structural	The lease provider's Registered Structural Engineer shall design and stamp the floor systems, including the Raised Floor System, to support the various types of loads described below, while also complying with local building and seismic codes and standards. Building structural floor load capacities shall be designed to support the weight and layout of server racks and equipment dead loads as well as floor live loads as defined by Tenant Operations. The Raised Access Floor systems (RAF) shall be designed to support IT rack distributed and point loads, and other equipment loads, as defined by Tenant Operations. Due to rack caster spacing and RAF tile dimensions, IT rack point loads shall, at a minimum, be 1/2 of the total IT rack load unless otherwise required. Move-in/move-out path is required to be along a solid tile with required load capacity and perforated tiles are not allowed.	Comply	
2.5.3.1	DCE Civil, Structural & Architectural (CSA)	Architectural	Datahalls shall be enclosed with a smoke barrier having a minimum 1-hour fire-resistance rating. Lessor's Professional Fire Consultant/Architect stamped design information shall be provided.	Exception	It is our understanding that it is not mandatory to house IDF rows within a separate fire rated compartments, actual design forecast two IDF rows housed within the same data hall space
2.5.3.2	DCE Civil, Structural & Architectural (CSA)	Architectural	Accommodation for standard server racks with 6 foot (1800 mm) minimum cold aisles and 5 foot (1520 mm) minimum hot aisles for maximum allowable IT Racks. The datahall perimeter shall include a minimum of 6 feet (1800mm) clear distance between the end of rack row and the nearest obstruction. Provide sufficient circulation and free area to promote safe operational access and datahall floor storage space (including Liquid Fill Carts), air flow and support hot aisle containment system structure where necessary. Where liquid cooled racks are installed, Lease Provider shall include floor mounted leak containment system. Landlord to provide containment design intent and ensure the containment does not prevent tenant racks from being rolled into position.	Comply	Leak Containement to ensure no obstruction to racks to be clarified with customer to ensure compliance
2.5.4.1	DCE Civil, Structural & Architectural (CSA)	Rack Dimensions	Maximum Rack Dimensions 600mm (W) x 1380mm (D) x 2600mm (H). Microsoft may utilize two rack width cabinet positions if the rack width exceeds 600mm.	Comply	
2.5.5.1	DCE Civil, Structural & Architectural (CSA)	Freight Elevator or Lift Capacity	There shall be at least two freight elevators, each having a minimum operation load capacity of 12,000 lbs (5440kg). The freight elevator's door clearance shall be 8-foot-wide (2440mm) and 10-foot-high (3050mm). Internal car depth shall be 8'-0" wide (2440mm) and 10'-0" deep (3048mm) clear min. They shall be able to operate under unevenly distributed load condition (heavy de-centered point load).	Comply	
2.5.6.1	DCE Civil, Structural & Architectural (CSA)	Rack Weights	Floor must support racks that weigh 4350lbs (1,974kg) with packaging and transport mechanism	Comply	
2.5.6.2	DCE Civil, Structural & Architectural (CSA)	Rack Weights	All facility floors must be capable of supporting 3,800 lbs. (1724kg) of weight per rack in a standing or rolling condition.	Comply	
2.5.7.1	DCE Civil, Structural & Architectural (CSA)	Loading Dock Door Clearances	Loading dock door clearances: 8 ft (2500mm) wide x 10 ft (3000mm) tall from dock platform.	Comply	
2.6.1.1	DCE Telecom	Property Entrance Points	There shall be four separate fiber property entrance points on to the property. Property Entrance vaults shall have a minimum of 150ft (50m) separation from each other. Two shall be designated as east (BLUE) and two as west (RED).	Comply	
2.6.2.1	DCE Telecom	Building Floor Plans	Landlord shall provide a tentative rack layout floor plan based on average row density. A standard row is a minimum of 22 server rack positions including 2 tiles for MOR (24 total).	Comply	
2.7.1.1	DCE IDF Telecom	IDF Space	Landlord shall provide 4 diverse and physically separated IDFs. All IDFs shall be located in tenant-controlled leased spaces and contiguous to Tenant Data Halls. If located in the same data hall, IDF's must be physically separated from each other by a minimum of 65' (20m). If 65' (20m) is not achievable in a single data hall, the IDFs shall be located in a physically separated space. Final IDF size to be confirmed by tenant.	Comply	Based on our discussions with MSFT to date regarding the new IDF requirements, our understanding is that a single row can be allocated for IDF racks , applying the same loading rationale as the other racks (i.e. average row load of 500kW with a maximum of 680kW), we will therefore allocate 2 IDF rows at opposing ends of the DH. Phase 1 will consist of two DHs so we will have a total of 4 IDF rows in phase 1 (2 per DH).

Req Id	Disc Section	Disc Subsection	Requirement	Landlord Response	Landlord Comment
2.8.1.1	DCE IDF Mechanical	IDF Cooling/Fire Protection	Landlord to provide diverse fire protection fault domains for all IDFs. Each IDF shall be protected by Double-interlock pre-action sprinkler system or gaseous suppression, and with very early warning detection system (VESDA). Individual IDFs within a single Data Hall, or COLO do not require dedicated sprinkler or VESDA zones, if "fusing" one sprinkler head in a particular IDF will not impact another IDF, and both triggers must be satisfied before water is released into the pipes. It is acceptable for the IDF to share COLO cooling air distribution system in an N+1 configuration.	Comply	Noted, considering the seperation distance is achieved per the above description, the fusing of a sprinkler adjacent to an IDF row will not impact the other IDF row within the same DH. In any case, since we have a double interlock system the fusing of a sprinkler would not result in discharging of water in the DH unless the fire alarm is activated.
2.9.1.1	DCE IDF Electrical	IDF Power	Landlord agrees to provide 4 separate, diverse, and physically separated fault domains (power, code required EPO) for IDF spaces. IDF power fault separation is required. 4 separate UPS primaries to be utilized. All IDF areas will be delivered with the same power distribution and power density (kW per row) as the standard Colo power along with supporting infrastructure. IDF space and power shall be allocated for the IDF only unless otherwise directed by the tenant.	Exception	It is our understanding that it is not mandatory to house IDF rows within a separate fire rated compartments, actual design forecast two IDF rows housed within the same data hall space
2.10.0.1	Operations	Dedicated Office Space	Landlord shall provide minimum Office Space based on campus capacity as stated below. Office Space must be turned over at RFS and be contiguous to the maximum extent possible. Office Space Requirement: -IF 2MW or less: 630SF minimum -2MW-10MW:3000SF minimum -10MW-25MW: Capacity required above AND 200SF/MW for additional capacity -25MW-50MW: Capacity required above AND 100SF/MW for additional capacity -50MW+: Capacity required above AND 50SF/MW for additional capacity For example, an 80MW site would require a total of 10,000SF. (3000SF + 15MW*200SF/MW + 25MW*100SF/MW + 30MW*50SF/MW = 10,000SF)	Comply	
2.10.1.1	Operations	Dedicated Storage Space	Landlord shall provide minimum storage space based on campus capacity as stated below. Storage must be turned over at RFS and be contiguous to the maximum extent possible. Storage Space Requirement: -2MW or less: 630SF minimum -2-20MW: 300SF/MW minimum -20MW+: Capacity required above AND an additional 200SF/MW for additional capacity For example, a 30MW site would require a total of 8000SF of storage. (20MW*300SF/MW + 10MW*200SF/MW=8,000SF)	Comply	

Req Id	Disc Section	Disc Subsection	Requirement	Landlord Response	Landlord Comment
3.1.1.1	DCE Mechanical Engineering (ME)	Contamination Thresholds in Server, Networking Equipment and Tape Libraries	Provide cooling infrastructure for each row sized for up to a 95% liquid-cooling proportion and approximately 44% air-cooling proportion, based on the design maximum row IT power.	Comply	
3.1.2.1	DCE Mechanical Engineering (ME)	Cooling Equipment for Server, Networking Equipment and Tape Libraries	The cooling units shall receive adequate tempered chilled water during the chiller restart period to maintain the temperature and relative humidity of respective Data Halls, Auxiliary Network Rooms, IDF rooms, and Tape Library spaces within the environmental requirements.	Comply	
3.1.2.2	DCE Mechanical Engineering (ME)	Cooling Equipment for Server, Networking Equipment and Tape Libraries	Cooling equipment is to be configured to automatically re-start following power failure to the unit itself.	Comply	
3.1.2.3	DCE Mechanical Engineering (ME)	Cooling Equipment for Server, Networking Equipment and Tape Libraries	Both direct expansion air-cooled chiller packaged unit or water-cooled chiller shall be provided with quick restart feature allowing chiller to resume operation in the shortest possible time and maintained the designed leaving chilled water temperature not exceeding 7 minutes.	Comply	
3.1.3.1	DCE Mechanical Engineering (ME)	Water Supply and Storage	Where used, open cooling towers shall receive make-up water to ensure continuous operation of the cooling systems including ad hoc water supply disruption caused by water utility company and also during preventive maintenance activities of Landlord's water reticulation system	Not applicable	Critical facility is air conditioned via air cooled chillers
3.1.4.1	DCE Mechanical Engineering (ME)	Cooling Pipework	If cooling water or condensate piping is run above Tenant's Equipment, a galvanized & welded metal pan or equivalent will be provided to contain any water leaks. The pan will be caulked to be watertight. In addition, it should be equipped with a leak detection system monitored by the BAS.	Comply	
3.1.4.2	DCE Mechanical Engineering (ME)	Cooling Pipework	If condensate lift pumps are used landlord will ensure that the pumps are provided with healthy, run and fault alarm monitored by the BAS. In the event of a condensate pump failure, a critical alarm is to be raised on the landlords BAS for immediate action	Comply	
3.1.5.1	DCE Mechanical Engineering (ME)	Outdoor Design Conditions	Design "summer" dry bulb: American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) n=20 extreme annual dry bulb temperatures.	Comply	
3.1.5.2	DCE Mechanical Engineering (ME)	Outdoor Design Conditions	Cooling tower design "summer" wet bulb: ASHRAE extreme maximum wet bulb temperature.	Not applicable	Critical facility is air conditioned via air cooled chillers
3.1.5.3	DCE Mechanical Engineering (ME)	Outdoor Design Conditions	Design "winter" dry bulb: ASHRAE n=20 extreme annual dry bulb temperatures.	Comply	
3.1.5.4	DCE Mechanical Engineering (ME)	Outdoor Design Conditions	ASHRAE 99.6 percent humidification dew point/ mean coincident dry bulb and humidity ration (HR) is used for humidifier sizing	Comply	
3.1.5.5	DCE Mechanical Engineering (ME)	Outdoor Design Conditions	Provide cooling performance ratings for ambient conditions at N=20-year extreme annual dry bulb temperatures + 2.8 degrees C or +5 degrees F. The purpose is to demonstrate how the cooling system will operate at extreme temperatures and to determine if cooling capacity, and therefore IT capacity, gets derated.	Comply	
3.1.6.1	DCE Mechanical Engineering (ME)	Fuel Oil Supply and Storage	The local control panel of the diesel fuel system shall be provided with battery or capacitor type solution that allows the control system and its components to ride through power outage or voltage dip.	Comply	
3.1.7.1	DCE Mechanical Engineering (ME)	Energy Efficiency	Mechanical and electrical system design per ASHRAE Standard 90.4 Energy Standard for Data Centers including all pertinent addendums.	Deviation	Design will be based on: "ISO 50001 and 14001 standards for energy management and environmental management and not the ASHRAE standard 90.4 Energy Standard for Data Centers including Addendum G as per item requirement."
3.1.8.1	DCE Mechanical Engineering (ME)	Fire Extinguishers	Lease Provider to provide FE-36 clean agent portable fire extinguisher in all COLO areas. "If FE-36 is not readily available in the region, lease provider can use a regional equivalent. Alternative product should be clean agent, low risk, low residue extinguisher suitable for use within sensitive electrical environments / data Centers. The provision and layouts of fire extinguishers shall be in conjunction with the fire protection strategy and shall also be approved by a fire protection engineer or suitably qualified specialist.	Comply	
3.2.1.1	DCE Building Automation, Monitoring & Control (BAMC)	Mechanical and Environmental Monitoring	HVAC controls for the HVAC equipment supporting the critical load shall be designed to match the availability and redundancy requirements of the equipment design.	Comply	
3.2.1.2	DCE Building Automation, Monitoring & Control (BAMC)	Mechanical and Environmental Monitoring	Landlord shall provide UPS, or some other means to ensure the monitoring and control power circuitry and its components are energized during power outage or voltage dip events.	Comply	
3.2.1.3	DCE Building Automation, Monitoring & Control (BAMC)	Mechanical and Environmental Monitoring	Mechanical and Environmental monitoring network to run on a secure, resilient, managed infrastructure, with no single point of failure for an area larger than one Data Hall, or suite. Network failure zones should be aligned with electrical and mechanical failure zones.	Comply	
3.2.1.4	DCE Building Automation, Monitoring & Control (BAMC)	Mechanical and Environmental Monitoring	Leak Monitoring required for fuel, condensate, humidifier, evaporative coolers, technology water piping, and at liquid cooled rack locations.	Comply	
3.2.1.5	DCE Building Automation, Monitoring & Control (BAMC)	Mechanical and Environmental Monitoring	Data Hall and ANR monitoring shall consist of airflow, temperature, relative humidity, and differential pressure sensors, as well as outside ambient conditions.	Comply	
3.2.1.6	DCE Building Automation, Monitoring & Control (BAMC)	Mechanical and Environmental Monitoring	Electrical room monitoring shall consist of temperature sensors and hydrogen (%LEL) sensors where applicable.	Comply	
3.2.1.7	DCE Building Automation, Monitoring & Control (BAMC)	Mechanical and Environmental Monitoring	The status of all HVAC equipment shall be monitored and reported to the DC Manager.	Comply	
3.2.1.8	DCE Building Automation, Monitoring & Control (BAMC)	Mechanical and Environmental Monitoring	Data archiving shall be provided at a 15-minute or less interval to include the minimum, maximum, and average of the value during that interval.	Comply	
3.2.1.9	DCE Building Automation, Monitoring & Control (BAMC)	Mechanical and Environmental Monitoring	Historical data and event logs shall be retained for 90 days minimum.	Comply	
3.3.1.1	DCE Electrical Engineering (EE)	Medium Voltage and Low Voltage cables	Medium voltage and low voltage cables shall be designed to carry 100% continuous design load based on the temperature rating of the cable selected and with all derating factors applied per code requirements and through soil thermal properties consideration. The cable temperature limit shall also take into consideration of the termination temperature and the equipment temperature rating	Comply	
3.3.2.1	DCE Electrical Engineering (EE)	Site Power Capacity	Site power capacity shall be as required to support all the IT loads, mechanical loads and any other loads on site. Electrical distribution on site and within the data center shall not be loaded above the nameplate rating for any component of the electrical distribution to deliver the contracted IT capacity. The total site capacity shall be assessed based on the contracted capacity and not actual usage	Comply	
3.3.3.1	DCE Electrical Engineering (EE)	Standby Generator Power	Standby rated, diesel engine generators (low voltage or medium voltage). Design of generator should include features necessary to power non-linear loads. This shall include: Low impedance alternators with ISO 8528 G2 transient complaint (X"d < 12%), isochronous electronic governors, true RMS three phase voltage regulators, PMG excitation system, starting battery monitoring system or dual starting batteries	Comply	
3.3.4.1	DCE Electrical Engineering (EE)	Uninterruptible Power Supply (UPS)	Static or rotary UPS systems are acceptable. -If Static, UPS shall be double conversion type and with VRLA / Pure Lead / Li-Ion batteries. -If rotary, UPS mechanical or VRLA / Pure Lead / Li-Ion battery ride-through energy source is acceptable. -UPS must be capable of operating with 0.95 leading and lagging power factor without derating	Comply	
3.3.5.1	DCE Electrical Engineering (EE)	Efficiency of UPS	The efficiency of the UPS shall be more than 96% in double conversion mode.	Comply	
3.3.6.1	DCE Electrical Engineering (EE)	Ride-thru Energy Source for the UPS	UPS shall be provided with VRLA / Pure Lead / Li-Ion batteries or mechanical ride-through to support the design load for sufficient time to transfer to and from generator source with worst case failure scenarios	Comply	
3.3.7.1	DCE Electrical Engineering (EE)	Battery Monitoring System for UPS Batteries	A battery monitoring system shall be provided which can monitor the health of individual batteries in the system including jar voltage, jar impedance, cell temperature, discharge logging and float current	Comply	
3.3.8.1	DCE Electrical Engineering (EE)	External Maintenance Bypass for UPS	A full external bypass for the UPS shall be provided for UPS periodic maintenance and load testing. The external bypass shall be provided with a solenoid key interlock to allow make before break transfer between UPS & external bypass and return and ensure no out of phase or dead bus transfers occur	Comply	
3.3.9.1	DCE Electrical Engineering (EE)	Medium Voltage Transformers	Oil or cast coil designs are acceptable. If oil, then less flammable type oil recognized by UL or FM global as such with a minimum fire point of 300 deg C. shall be utilized along with spill containment as required by local codes. Mineral oil shall not be used	Comply	

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3.3.10.1	DCE Electrical Engineering (EE)	Electronic Circuit Breakers and Protective Relays	Medium voltage circuit breakers shall be equipped with solid state protective relays to provide circuit protection. Low voltage circuit breakers 400 amps and larger shall utilize electronic trip units for circuit protection	Comply	
3.3.11.1	DCE Electrical Engineering (EE)	Electrical Coordination, Fault Current, and Arc Flash Study	A complete study shall be performed to confirm system is fully rated (no series rating) for the available fault current all the way to the rack level in the design. If the lease provider's scope ends before the tap-off box, lease provider shall submit a coordination study, including tap off breaker during IFC review cycle. Microsoft fit-out team shall provide necessary details to the lessor to complete the coordination study. The electrical system shall be fully coordinated to minimize impact of faults. The PDU main and feeder Breaker and / or Busway feeder breaker instantaneous trip setting shall be set as a minimum of 5 x design load current of the distribution system it is serving. The lease provider will need to coordinate the upstream breaker trip settings based on these values. An arc flash study shall also be performed, or an arc resistant switchgear design shall be provided to ensure system can be operated and maintained in a safe manner.	Comply	
3.3.12.1	DCE Electrical Engineering (EE)	Lightning Protection	Lightning Protection Systems shall be installed and listed by UL using the UL96A Standard and information from NFPA 780 or approved and equivalent standards for design	Comply	
3.3.13.1	DCE Electrical Engineering (EE)	Transient Voltage Surge Protection	The incoming medium voltage switchgear shall include distribution and intermediate class lightning surge arrestors. Every low voltage bus shall include UL or CE listed Transient Voltage Surge Suppression devices (TVSS). These shall be designed to limit over voltage transient events from damaging the servers or the other critical datacenter equipment	Comply	
3.3.14.1	DCE Electrical Engineering (EE)	Static Transfer Switches	If STS is provided, the system shall be with full maintenance bypass design capable of full out of phase transfer between sources with transformer loads such that transformer inrush is eliminated or reduced to no more that 2x the FLA of the transformer. Static switch design shall limit voltage transient excursion to values within the ITIC computer power tolerance curve. All out of phase transfer times shall not result in outage to the IT loads longer than 20 milliseconds maximum. Harmonic voltage distortion must remain below 5% THD peak under steady state conditions	Comply	
3.3.15.1	DCE Electrical Engineering (EE)	Drives for the Mechanical Equipment	ECM/ VFDs and solid-state devices used on the mechanical system shall be designed to reduce the reflected harmonics back into system and comply with IEEE 519. The Current harmonics (THDi) shall be less than 5% of fundamental	Deviation	Reference Standard is EN61000 in place of IEEE 519
3.3.16.1	DCE Electrical Engineering (EE)	Lighting	The light fittings within the premises shall be high frequency fluorescent / LED luminaires. Data halls shall be provided with a minimum of 500 Lux / 50fc @ 36 inches above finished floor (AFF) and the other leased spaces and areas shall be provided with 250 lux / 25fc @ 36 inches AFF. Lighting will be provided for all tenant leased areas inclusive of administration, storage, office, and shredder location	Comply	
3.3.17.1	DCE Electrical Engineering (EE)	Emergency Lighting	Emergency lighting shall comply to all local statutory requirements and security requirements. The emergency lights shall automatically illuminate in the event of a general mains failure	Comply	
3.3.18.1	DCE Electrical Engineering (EE)	Non-Critical Power	The installation will consist of small power outlets to ensure that any machinery required within the premises (cleaning equipment or additional lighting) can be supplied locally. Provide one (1) Ceiling Mounted electrical outlet in each cold and hot aisle, 120/240 volt, 15 amp for tenant's procured and installed cord reels	Comply	
3.3.19.1	DCE Electrical Engineering (EE)	Electrical Earthing Topology	The earthing system for the final rack power supply shall be a solidly grounded separately derived source transformer design that bonds neutral to ground at single point with transformer located within 25 feet of the server racks as detailed in IEEE 1100 chapter 8 or equivalent local standards. This is also known as TNS system of earthing. Ground grid shall be designed to achieve a maximum of one-ohm resistance to earth. All feeders and branch circuit shall include an equipment grounding conductor	Comply	
3.3.20.1	DCE Electrical Engineering (EE)	Datacenter Grounding (Earthing)	Provide earthing / grounding bars consisting of hard drawn copper bar. Provide a minimum of one Telecommunication Ground/Earthing Bar for each 3 server rows, sized to TIA 607 specifications, and placed such that all server cabinets, cable trays and other metallic hardware may be connected to this grounding Bar. Grounding bar shall be located above the finished floor. The final location will be agreed with Tenant. All Datacenter equipment and other metal parts shall be bonded to the ground grid to provide an equipotential ground system. Racks shall be bonded to ground bar as per TIA 607 requirements	Comply	
3.3.21.1	DCE Electrical Engineering (EE)	Floor & Pedestal Earthing	Landlord will supply and install an earthing system which will provide an adequate grounding of all floor tiles back to the main building earth to comply with IEEE recommendation of multi point grounding or equivalent standards	Not applicable	No raised floor being provided in Critical areas
3.3.22.1	DCE Electrical Engineering (EE)	Electrical Cable Tray	Provide electrical containment systems and Equipment. This installation will take into account the designs prepared by Tenant. Containment for the power cabling - cable tray / ladder / trunking with necessary capacity and diversity shall be provided to meet the requirements. The containment shall provide adequate separation from data / telecom system to mitigate any EMC related impacts and shall be as a minimum 12 inches (300mm) away for the telecom cabling system. The power supplies shall be installed in secure containment if routed in common area	Comply	
3.3.23.1	DCE Electrical Engineering (EE)	Arc Flash Hazard Mitigation	The design shall incorporate arc flash reduction features. This can include arc resistant switchgear, reduced arc flash breaker settings, or other equivalent technology to reduce risk	Comply	
3.3.24.1	DCE Electrical Engineering (EE)	Automatic load transfer	Automatic load transfer should be designed for load transfer between utility source and standby generator. All outgoing breaker downstream of automatic transfer switch should be in normally closed position and no manual intervention is required to close any of the breaker	Comply	
3.3.25.1	DCE Electrical Engineering (EE)	Office and Storage	The Landlord will provide Electrical Power Distribution panels with generator backup to feed all tenant leased areas as part of the initial construction to be delivered at Ready for Service	Comply	
3.4.1.1	DCE Electrical Power Monitoring Systems (EPMS)	Electrical Power Monitoring	All Electrical Monitoring devices to be on a battery-back power source (UPS or station battery) to ensure continuity of monitoring during power disturbances. To include servers, workstations, network switches, gateways, meters, I/O modules, trip units, controllers, etc.	Comply	
3.4.1.2	DCE Electrical Power Monitoring Systems (EPMS)	Electrical Power Monitoring	Electrical monitoring network to run on a secure, resilient, managed infrastructure, with no single point of failure for an area larger than one Data Hall, or suite. Network failure zones should be aligned with electrical and mechanical failure zones	Comply	
3.4.1.3	DCE Electrical Power Monitoring Systems (EPMS)	Electrical Power Monitoring	No wireless communication protocols of any kind shall be used in the Electrical monitoring systems without specific Tenant approval	Comply	
3.4.1.4	DCE Electrical Power Monitoring Systems (EPMS)	Electrical Power Monitoring	Circuit breaker status to include: Medium Voltage: Open/closed, tripped and withdrawn (for withdrawable breakers) Low Voltage: Open/closed and withdrawn (for withdrawable breakers)	Comply	
3.4.1.5	DCE Electrical Power Monitoring Systems (EPMS)	Electrical Power Monitoring	ATS/STS monitoring to include: Connected source (preferred, alternate, etc.) Source availability Controller status (normal, warning, failure) Mode of operation (auto, manual, bypass, etc.) Circuit Breaker Status	Comply	
3.4.1.6	DCE Electrical Power Monitoring Systems (EPMS)	Electrical Power Monitoring	UPS monitoring to include: Output availability Current and voltage THD current and voltage THD Status (normal, warning, failure) Mode of operation (auto, manual, bypass) Battery monitoring and data management (BMS) Circuit Breaker Status	Comply	
3.4.1.7	DCE Electrical Power Monitoring Systems (EPMS)	Electrical Power Monitoring	Utility service entry monitoring to include: Power Revenue grade energy metering (ANSI C12.20 0.2 compliant, Voltage: 0.2% reading minimum, Current: 0.2% reading minimum, Frequency: 0.2% reading minimum) Metering at Tenant power connection point (to include all Tenant-dedicated power distribution) Circuit Breaker Status	Comply	
3.4.1.8	DCE Electrical Power Monitoring Systems (EPMS)	Electrical Power Monitoring	Power metering at Tenant power connection point (to include all Tenant-dedicated power distribution). Metering to include voltage, current, kW and kWh	Comply	

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3.4.1.9	DCE Electrical Power Monitoring Systems (EPMS)	Electrical Power Monitoring	Individual power metering of each server row at the busway input or PDU output (RPP input), including voltage, current kW and kWh. The accuracy in measurement should be Voltage: 0.5% reading minimum, Current: 0.5% reading minimum	Comply	
3.4.1.10	DCE Electrical Power Monitoring Systems (EPMS)	Electrical Power Monitoring	PDU monitoring to include: Power quality metering, current THD, voltage THD, sag/swell detection, waveform capture, power quality (ITIC) reporting and Circuit Breaker Status. ITIC reports plot magnitude and duration of all power quality events against the ITIC curve. Metering to be located downstream of potential sources of transients or harmonics, such as UPS's and STS's	Comply	
3.4.1.11	DCE Electrical Power Monitoring Systems (EPMS)	Electrical Power Monitoring	Data archiving shall be provided at a 15-minute or less interval to include the minimum, maximum and average of the value during that interval	Comply	
3.4.1.12	DCE Electrical Power Monitoring Systems (EPMS)	Electrical Power Monitoring	Historical data and event logs shall be retained for 90 days minimum	Comply	
3.5.1.1	DCE Civil, Structural & Architectural (CSA)	Receiving Area	The Receiving Area will be used as a transitional space to uncrate materials coming into the Data Center and for short term storage. Access must be controlled in this space and enough area provided for up to 22 racks of prepopulated equipment in a single delivery. The receiving area requirements shall be determined on a case by case basis but shall not be smaller than 400sf (40 sqm). This is not classified as part of the secure storage area as defined by Tenant operations.	Comply	
3.5.2.1	DCE Civil, Structural & Architectural (CSA)	Secure Storage Area	A Secure Storage Area shall be provided for storage of high value components and capable of being sub-divided into multiple cage areas including dedicated secure area for high value storage. This area is also to include a secured area for storage of media.	Comply	
3.5.3.1	DCE Civil, Structural & Architectural (CSA)	Move In, Move Out (MIMO) Path	The following shall be validated by lease provider's structural engineer. The entire IT Rack deployment travel path (Move In, Move Out - MIMO) must be suitable for the requirements of the pre-rack SKU weights and clearances (as defined in the A2). No special cases are allowed, such as tipping of racks or removal of equipment from racks. The entire route along the rack move-in path from loading area to the Colos shall be level (meeting a 'flat' classification per latest approved revision of ACI302.1), capable of supporting the rolling load of fully populated racks on a transport mechanism rested on casters (four point load). There shall be no obstacles such as curbs, ramps or drops along the entire route. Any service ramps along a route shall be reviewed on a case-by-case basis. Internal Clearances Between Loading Dock and the Data Hall shall be 6'-0" wide x 10'-0" high (1800m wide x 3050mm high). Clear widths and heights should be free from obstructions.	Comply	
3.5.4.1	DCE Civil, Structural & Architectural (CSA)	Loading Dock	The loading dock area shall be 4ft (1200mm) above the external site level, feature 2 dock levelers/scissor lifts, include an external canopy, and top/side dock weather sheeting for dry loading/unloading via a variety of delivery vehicles types with/without tail lift ups, including up to maximum WB67 (AMER) & 16.5m HGV (EMEA/APAC). Forklift truck unloading is not permitted and scissor lifts must provide H&S guarding/protection to the platform and underside. The interior(dry) loading bay area must be minimum 16ft (5m) from inside edge of dock leveler for fork lift turning. Loading, shipping, receiving, and loading dock adjacent storage areas will have a 13ft (3960mm) overhead clear distance from finished floor to lowest overhead obstruction to allow for rack unboxing and to allow for storing on shelving without damaging overhead lights, security cameras, sprinkler heads, etc. A single loading dock area shall serve up to maximum 48MW of leased capacity per building. Example: 54MW = 2 loading dock areas (total 4 dock levelers/scissor lifts).	Comply	
3.5.5.1	DCE Civil, Structural & Architectural (CSA)	Roof	Roof shall be designed by a qualified building envelope design professional specifically for the Data Center. Roofing systems shall be designed as contiguous liquid, vapor, and thermal barriers. Roof penetrations are not allowed over critical areas, i.e. IT, Network and infrastructure. The roof waterproofing system shall carry a standard manufacturer's guarantee for a period of not less than twenty (20) years and an installer's guarantee for a period of not less than five (5) years. Tenant lease shall fall within the roof manufacturer's warranty period. Tenant shall be notified in writing prior to any roofing or repair activities that are to occur during the course of this lease	Comply	
3.5.6.1	DCE Civil, Structural & Architectural (CSA)	Doors	The ingress/egress IT rack move-in path doors will be provided with a minimum opening of approximately 6 foot (1800mm) and a minimum height of 10 foot (3000mm) to facilitate the installation of large pieces of IT equipment.	Comply	
3.5.7.1	DCE Civil, Structural & Architectural (CSA)	Ceilings	The following shall be validated by lease provider's structural engineer. Ceilings structure within the lease space will be of suitable construction to be able to support all equipment which is proposed. This will typically include a dual cable laddering system which is suspended from a Uni-strut grid and able to support all required equipment and support tray hanging loads. Typical minimum dead load criteria for hanging loads in Tenant build projects is 30psf (1.45 kN/m2).	Comply	
3.6.1.1	DCE Telecom	Property Entrance Point to Entrance Room (ER)	entrance rooms/MMRs as follows: -6 x 4" (100mm) from SPV1 to West/Red ER/MMR -6 x 4" (100mm) from SPV2 to East/Blue ER/MMR -6 x 4" (100mm) from SPV3 to West/Red ER/MMR -6 x 4" (100mm) from SPV4 to East/Blue ER/MMR Conduit bend radius needs to maintain 10X inner diameter of the internal dimension of the conduit. The Landlord shall ensure the cables entering the facility are protected with nonrigid inner sub-ducting or sleeves. Additional 6 conduits per SPV shall be added if ANR is present or if greater than three buildings are planned for the campus.	Comply	
3.6.2.1	DCE Telecom	Entrance Rooms (ER)	There shall be a minimum of two ERs/MMR's for the telecoms system in the facility. One ER/MMR shall be designated as the logical west (RED) room and the other shall be designated as the logical east (BLUE). ER/MMR shall be physically separated by at least 65ft (20m). Landlord shall provide one floor cabinet at least 45RU in height and 18" (450mm) in depth for Tenant-provided splice housings. Cabinet shall contain rails to mount 19" equipment. ER/MMR shall be a minimum of 144sq ft (16sqm) and LP shall ensure 4ft (1.2m) or clear space in front of MMR rack. LP shall reserve equivalent of one full wall for splice enclosures. Final location of equipment shall be confirmed with Tenant.	Comply	
3.6.3.1	DCE Telecom	Secure pathways from Entrance Rooms (ER) to Leased Spaces (Data Hall)	The Landlord shall provide a minimum of four secure network pathways dedicated to Tenant, sized 18" (150mm) (H) x 6" (450mm) (W). Two of the routes shall be designated as logical east (BLUE) and the other two shall be designated as logical west (RED) (to be defined by Tenant). East and west routes shall be separated by a minimum horizontal distance of 65ft (20m). Pathways shall be well protected against accidental damage and shall be accessible for cable installation, dressing, and future moves adds and changes. Pathways shall be located within the facility but may reside outside the leased areas (Data Halls); secure pathway shall be steel duct within the facility and PVC conduit outside the facility. Alternately, in multi-story buildings routes may be run on separate floors in separate fire compartments, East and West routes shall not cross unless separated by at least one floor and in different fire compartments. Coordinate final interior pathway locations with tenant.	Comply	
3.6.4.1	DCE Telecom	Secure pathways between Tenant Leased Data Halls (Multiple Data Halls)	Provide containment connecting all data halls/rooms with all IDF locations, using diverse routes designated as east (BLUE; connecting IDF's 2&4) and west (RED; connecting IDF's 1&3). East and west routes shall be separated by a minimum of 20m horizontally. Alternately, in multi-story buildings routes may be run on separate floors in separate fire compartments. East and west routes shall not cross unless separated by at least one floor and in different fire compartments. Pathways shall consist of one 150mm x 450mm (6"x18") steel containment per 5MW, per route. If the pathway traverses underground, then HDPVC conduit is acceptable instead of steel containment. For the HDPVC conduit the landlord to provide two diverse paths consisting of two 100 mm (4") HDPVC conduits per 1 MW, per route. Each path shall be dedicated to Microsoft. Containment shall be well protected against accidental damage and shall be accessible for cable installation and dressing, including future moves adds and changes. Provide containment connecting each data hall to the Tenant's office area. Pathways will consist of one 150mm x 450mm (6" x 18") steel containment or one 100mm (4") HDPVC conduit.	Comply	
3.6.5.1	DCE Telecom	Data Hall Vertical Clear Space	Minimum of 12.5ft (3.8m) of vertical clearance between the finished floor and the first obstruction prior to tenant fit out scope.	Comply	
3.7.1.1	DCE IDF	IDF East/ West	Landlord agrees that IDFs 1 and 3 shall be designated as "West" IDFs. IDFs 2 and 4 shall be designated as "East" IDFs. Each "West" IDF shall be connected to the "West" Entrance Room by providing a minimum of two 4" (100mm) secure conduits or trunking along a "West" route in the facility. Each "East" IDF shall be connected to the "East" Entrance Room by providing a minimum of two 4" (100mm) secure ducts along an "East" route in the facility. The "East" route and the "West" routing of conduits or trunking shall maintain a minimum separation of 65' (20m) the entire route.	Comply	

Req Id	Disc Section	Disc Subsection	Requirement	Landlord Response	Landlord Comment
3.7.2.1	DCE IDF	IDF Racks	IDF's must support 4 post racks of the following outer dimensions: - 20.31" (515.9mm) wide (inner dimensions:18.31" (465.1mm) wide) - 18.31" (914.4 mm) deep - 52 RU tall with 12" (300mm) wide single sided 8" (2.4m) minimum high vertical cable managers between each rack and at end of each rack row IDF must provide hot and cold aisle and side aisle clearances as noted herein in with regard to minimum row sizing, as noted in CSA technical requirements section. Measurements are from front and/or rear rail face of rack.	Comply	
3.8.1.1	DCE TELECOM ANR & AZNG	ANR Racks	ANR must support 4 post racks of the following outer dimensions: - 20.31" (515.9mm) wide (inner dimensions: 18.31" (465.1mm) wide) - 36" (914.4 mm) deep (inner dimension: N/A) - 52 RU tall total 96.18" (2443mm) with 12" (300mm) wide single sided 8" (2.4m) minimum high vertical cable managers between each rack and at end of each rack row ANR must provide hot and cold aisle and side aisle clearances as noted herein in with regard to minimum row sizing, as noted in CSA technical requirements section. Measurements are from front and/or rear rail face of rack.	Comply	
3.8.2.1	DCE TELECOM ANR & AZNG	ANR/AZNG Pathways	For connections between the ANR and IDF locations, the Landlord will provide a minimum of four secure network pathways dedicated to Tenant, sized 18" (150mm) (H) x 6" (450mm) (W). Two of the routes shall be designated as east (BLUE) and the other two shall be designated as west (RED) (to be defined by Tenant). East and west routes shall be separated by a minimum horizontal distance of 65' (20m). The pathways shall be routed to enable the four IDFs in the facility connection to the AZNG. Pathways shall be well protected against accidental damage and shall be accessible for cable installation, dressing, and future moves, adds, or changes. Pathways shall be located within the facility but may reside outside the leased areas (Data Halls); secure pathway shall be steel duct within the facility and nonflexible conduit outside the facility.	Comply	
3.8.3.1	DCE TELECOM ANR & AZNG	ANR East/West	In a facility with an IDF, the Landlord must coordinate all "West/East" pathways such that IDF and ANR pathways are aligned and all "West" pathways maintain a 65' (20m) separation from all "East" pathways If AZNG and IDFs are in the facility, AZNG is required to connect to each IDF with both East and West paths and maintain full separations.	Comply	
3.9.1.1	DCE MECHANICAL ANR & AZNG	Auxiliary Network Room (ANR)	ANR shall have separate and dedicated double interlock pre-action sprinkler ZONE or gaseous suppression with very early warning detection (VESDA or similar)	Deviation	The ANR (AZNG) is considered inside the data hall and served from the same double interlock pre-action sprinkler zone of the data hall.
3.10.1.1	DCE ELECTRICAL ANR & AZNG	ANR Power Redundancy	The power for ANR must not be used for other IT loads and reserved at the capacity value specified for future ANR growth. All ANR areas will be delivered with the same power distribution and power density (kW per row) as the standard COLO power along with supporting infrastructure.	Comply	
3.11.1.1	Operations	Shredder Requirements for Sites with Contracted Capacity Equal to or Less than 5MW	Space: Landlord shall provide 15'x25'x9' (D x W x H) w/ solid floor or high-density panels (Shredder weight = 5,000 lbs. across 4 casters + Pallet w/ up to 1,600 lbs. debris); solid wall enclosure where possible. Note: Shredder space requirement is not required for sites less than 5 MW.	Not applicable	Site contracted Capacity is greater than 5MW
3.11.1.2	Operations	Shredder Requirements for Sites with Contracted Capacity Equal to or Greater than 5MW	Shredder Power: The landlord shall provide at least one of the following power options at each shredder location: 208V, 3 Phase, 50/60 Hz 100 Amps; 230V, 3 Phase, 50/60 Hz 100 Amps; 380V, 3 Phase, 50/60 Hz 60 Amps; 400V, 3 Phase, 50/60 Hz 60 Amps; 415V, 3 Phase, 50/60 Hz 60 Amps; 460V, 3 Phase, 50/60 Hz 40 Amps; 575V, 3 Phase, 50/60 Hz 40 Amps; Note: Shredder power requirement is not required for sites less than 5 MW.	Not applicable	Site contracted Capacity is greater than 5MW
3.12.1.1	Critical Environment System Intelligence (CESI) Shared Telemetry	Shared Telemetry from Monitoring Systems	mechanical monitoring systems serving Tenant dedicated lease space. Where applicable, data points will be similar to: Electrical: Amps and kW from input to Busway/RPP Volts, Amps, kW, kWh and Summary Alarms from the PDU input and above Volts, Amps, kW, Engine run hours, Number of starts for Generators Mechanical: Floor Temperature and Humidity Supply and Return air Temperature, Humidity , FAN Speed and STATUS for air handling units Full list of data points to be provided after approval of colo level electrical distribution and BAS floor layout	Comply	

Req Id	Disc Section	Disc Subsection	Requirement	Landlord Response	Landlord Comment
3.12.1.2	Critical Environment System Intelligence (CESI) Shared Telemetry	Shared Telemetry from Monitoring Systems	Data will be supplied to Microsoft using only one of the two methods described below. Performance characteristics are common for both platforms. The preferred method is integration of the Lessor's Data Center Information Management (DCIM) system with Microsoft's Software Defined Lease Telemetry (SDLT) platform. This requires the Lessor to make available -an Internet-accessible so ware endpoint, such as MQTT gateway, Azure Event Hub, or proprietary API to the DCIM system -uses OAUTH and cer ficate-based connec ons for secure authen ca on -TLS 1.2 for data encryp on (again, cer ficate-based) -Message payload using either JSON or MQTT -Lessor's DCIM publishing pla orm shall provide all data points listed in Sec on 03.18.01.01 at 1-minute intervals -Lessor's DCIM publishing pla orm shall provide data within a 15 second window measured as the time span between when the data value is generated by the monitored device and when it is published to Microsoft through the DCIM platform -Lessor's SDLT publishing pla orm shall be concurrently maintainable, and support 99.9% API availability measured as successful data retrieval at each site per the above performance characteristics Microsoft can provide additional details on message format, authentication handling, and software integration processes as needed. The alternate method – Hardware Defined Lease Telemetry (HDLT) uses a Purdue Network Model to connect a secured Aggregation Device (AD) to the EPMS and BAS networks of the Lessor's facility, using a non-routable network (2-wire RS-485) and one-way, directional access-controlled protocol (Modbus RTU) to ensure network isolation and security. The AD can be Programmable Logic Controller (PLC), Direct Digital Controller (DDC), Open Platform Communications Data Access (OPC-DA) device, or similar. The AD is to be procured, managed, secured, and operated by the Lessor. Microsoft will support programming the AD, though all programming will be performed by the Lessor. The aggregation device (AD) should poll all pertinent data points from the Lessor's internal BAS/EPMS/SCADA systems at the frequencies indicated in the data points table listed above. There will be at least two (2) Aggregation Devices installed at each facility (defined as Microsoft Site Code). Each Aggregation Device must -Use its own dis nct power feed, and each feed must be fed by the same UPS as the Lessor's EPMS and/or BAS system -Have its own unique network pathway to the lessor's EPMS and BAS network Lessor will also procure and install two (2) pre-defined cabinets with supporting components. Microsoft will direct the Lessor to the appropriate supplier for the unit. Specifications, design drawings and estimated costs will be provided by the designated supplier. Each cabinet will use its own distinct power feed, and must be backed up by a non-Critical Equipment, Uninterruptible Power Supply (UPS) typically referred to as "House Power" or "Non-IT-Load Power." 16 pairs of RS485 cables are to be terminated at each IPC enclosure, with the other end terminated at a terminal block adjacent to the ADs. The surplus pairs will serve as spares for future expansions or design modifications. Microsoft will program and install gateway devices (LTHP) using the RS-485 connections. Lessor will be provided review of the MODBUS programming used to map Aggregation Device data points to LTHP data points. Lessor will provide and install cable trays, EMT conduit or plastic cable ducts from Microsoft provided internal CorpNet switch cabinet and install (8) CAT6 ethernet cables from Microsoft provided CorpNet switch cabinet to the lessor installed LTHP cabinet. The distance from the lessor installed LTHP cabinet to the Microsoft provided CorpNet switch cabinet shall be less than 100 meters. Lessor shall coordinate installation of LTHP with Microsoft to ensure adequate proximity to Microsoft provided	Comply	
3.13.1.1	Critical Environment System Intelligence (CESI) Power Hierarchy Capture	Power Hierarchy Capture	The site's Single-Line Diagrams (SLDs) / One-Line Diagrams (OLDs) for electrical design are to be supplied by the Lessor to the Customer at two different milestones. -First, Issue for Construc on drawings will be provided to Microso 120 days prior to the Ready For Service (RFS) milestone for new sites, or 90 days prior to RFS for expansions to existing facilities. -Second, As-Built drawings will be provided within 30 days of the Ready for Service (RFS) milestone. All drawing sets will include: -All drawings will use per-device unique naming. The name of the device itself should be the name represented on the drawing, not the target device name -Complete site Single-Line Diagrams (SLDs) / One-Line Diagrams (OLDs) for the en re facility, reflecting current site conditions as of the RFS milestone -Explicit iden fica on of the Cri cal Environment components that supply power to the Customer's intended spaces and workloads. Examples include, but are not limited to, Utility Transfer Switchgear, Medium Voltage Switchgear, Low Voltage Switchgear, Uninterruptable Power Supply, Power Distribution Unit / Universal Distribution system, or any other CE equipment that supplies power to the Customer's intended workload -Explicit iden fica on of any Cri cal Environment equipment that is specifically NOT assigned to supporting the customer's workload -All electrical panels and device names used for EPMS monitoring should be clearly labeled -All devices should have electrical ra ngs for Voltage, Current (AT) and where applicable kW and or KVA -All breakers assigned to Tenant should be labeled with a Normally Open (NO) status, when the default is Normally Closed (NC) -All PDU/UDS breakers assigned to supply Tenant assets must have a mapping to an RPP or Busbar -All PDU/UDS breakers assigned to supply Tenant assets must iden fy redundant rela onships (i.e. PDU01-FB1 to PDU02-FB1) -All RPP or Busbars must have a room/space/data hall designa on (i.e. PDU01-FB1 > DCName-F01C01-RPP01) [Colocation names must be provided in MS nomenclature] -All RPP or Busbars must have a list of Tile Loca ons/Alpha Numeric Grid iden fiers that map to racks (i.e. DCName-F01C01-RPP01 > AB108, AV109, AB110, etc.)[Colocation names must be provided in MS nomenclature]	Comply	

APPENDIX C – STACK DESIGN DECISION TRACKER

01 This Appendix includes a summary of key design coordination and decisions agreed with Stack for the specific site.

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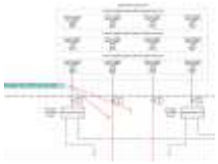
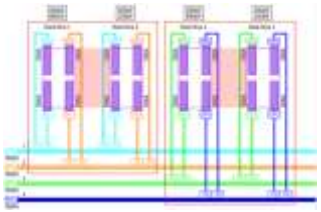
MIL08A Design Decision Tracker										
Item #	**Date Opened**	**Days Active**	**Priority**	**Status**	**Discipline**	**Deliverable Impacted**	**Useful Links**	**Question / Available Options**	**Direction / Decision**	**DCO#**
1	04.11.2024	0	**P4 - Information**	Request to Close	General	Stage 3 pack		Please note for stage 2 design decisions, please refer to the MIL04D DDT as this was used for the three projects that ran concurrently at stage 2 (MIL04D, 05B, 08A).	[10-Dec-24 MDB] Noted	
3	04.11.2024	0	**P1 - High**	Request to Close	General	Stage 3 pack		[041124 YE] MIL08A - IDFs & ANR/AZNG Our understanding is that MIL08A will have large IDF and ANR/AZNG. Please advise if the row/rack arrangement for MIL08A be as per MIL05A.	[10-Dec-24 BT] MIL08A will have small IDFs + Large B RNG/ANR. DH arrangment to follow MIL05A except for IDFs which are small	
4	04.11.2024	0	**P2 - Medium**	Request to Close	General	Stage 3 pack		[081024 MA] Fuel Filling Arranegment Design team will develop the fuel filling arrangement based on location of fuel truck rest areas on site, while maintaining individual filling points and pipework for each generator rather than a central filling point and loop , in-line with the Steer design and the pros/cons comparison provided on MIL05A, mainly to avoid complexity and additional cost associated with additional valves and motorized valves and associated works which expected to be higher for the central option as advised by local team. Please confirm.	[10-Dec-24 BT] Same strategy as MIL05 is acceptable considering Client acceptance	
5	04.11.2024	0	**P2 - Medium**	Request to Close	General	Stage 3 pack		[041124 OH] MIL08A - Admin Block layout / general. MIL04D / 08A projects are required to follow B-class requirements. SER & SOC rooms to be incluced within admin block layout. Stack to confirm if there are any SOQ updates required as this has been updaed post stage 2.	[10-Dec-24 BT] SER & SOC specs can be found into SOQ tracker (Exhibit A2) and PSB4. Both documents have been provided to AE	
6	08.11.2024	0	**P1 - High**	Request to Close	Electrical	Stage 3 pack		We would like to propose the removal of two of the STS's, replacing them with a direct connection from the MSB as shown in the screenshot below. There will be no impact on the system's load capacity, as the remaining two STS's will maintain their 1000 kW maximum load rating, with them serving two rows of either 500kW + 500kW or 680kW + 320kW, as per Journey's requirement. There is also a cost saving without sacrificing system reliability or capacity. 	[10-Dec-24 BT] Change should be tracked as deviation from STEER. AE please confirm if same solution has been adopted for STEER v2. Cost reduction is also expected	
7	13.11.2024		**P1 - High**	Request to Close	Architecture	Stage 3 pack		Rainwater Drainage - Admin Block 1. The curtain wall façade windows does not allow for the installation of downspouts on the main facade. As illustrated in the render in the BOD, no downspouts are foreseen on this facade, and their addition would significantly affect the building's aesthetics. 2. The narrow and elongated configuration of the Admin block. 3. According to the BOD: No roof drains or leaders shall be located over the data centre. Roof pitch to drain to external scuppers and downspouts through parapets.	[11Dec24 - JL] As noted on the MIL04D DDT and via email on 20Nov24, STACKs preference is for option 2 as per the description in the email sent and copied below: Option 2) Downspouts on the long side of the building • This solution would require a roof slope of only 40 cm, having a smaller impact on the usable space for installations. • The water flow path, at around 18 meters, would be shorter and safer. We have no concerns with locating internal downspouts in the admin/office areas but please ensure they are located away from any technical areas/electrical rooms such as MMR or POE.	
8	22.11.2025		**P1 - High**	Request to Close	Electrical	Stage 3 pack		During a meeting with the Journey Mechanical SME on MIL05, one point raised was regarding the row busbar distribution. Aaron from Journey explained that there is currently no specific requirement for contiguous 680kW rows. However, he did mention that from an operational perspective it would be easier for Journey if each HAC had the same A & B supply (see image below). As each HAC is a maximum of 1MW (as per Journey electrical SME) and each distribution busbar is 1600A (which can take 1MW), we propose this change be implemented, as it would result in shorter and simpler busbar runs (the 1600A would be the length of each HAC as opposed to serving both HACs). 	[10-Dec-24 BT] Change should be tracked as deviation from STEER. AE please confirm if same solution has been adopted for STEER v2. Cost reduction is also expected	

APPENDIX D – STEER DEVIATION TRACKER

01 This Appendix includes the list of key Steer BOD design deviations agreed with Stack for the specific project due to localization, customer requirements or VE.

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PROJECT STEER DEVIATION LOG
Project Reference: MIL08A

Devaiations applicable to STEER Design Document - STEER-BWE-XX-XX-RP-N-00004 - STACK BOD V P01 - Stack EMEA European Reference Design (Steer)

Number	Disipline	Subject	Steer Design - BOD	Deviation from Steer Design	Reason for deviations
1	MEP	Data Hall arrangement	Two storey 24MW building with 4 x 6MW data halls.	In this project it's a single storey 20MW Data Hall Building to comply with the local hight limits.	Localisation
2	ELE	Power module arrangement	Power modules were double stacked and handed in two layers with chiller on the roof.	Power Modules are all placed on ground floor due to the height limitation of the site. In addition, based on local regulations it is needed to leave at least 3m distances from generators and any other flammable elements.	Localisation
3	MEC	Chilled water generation system	Critical system shall have a peak PUE of 1.35, based on the use of water cooled chillers and adiabatic dry coolers.	- Using water cooled chiller solution would take us above the maximum allowable building height and GFA. - Due to uncertainty on process water availability, air cooled chillers have been considered.	Localisation - (MIL05A-RFI009)
4	MEP	Electrical topology	3 to make 2 distributed redundant line ups per 24MW block using 2.4MW Generators to serve critical mechanical equipment	Given the higher power demand of air cooled chillers, see no. 3 above, electrical system topology needs to increase in capacity. 5 to make 4 distributed redundant line ups per 20MW block using 2.4MW Generators to serve critical mechanical equipment	Localisation referred to no. 3 above
5	MEP	Fire Prevention System	BOD shows many regulations to be follow per Fire Prevention System, refer to chapter 8 (EN 12845, EN671, FM Global etc…)	Agreed with Stack to proceed with NFPA for internal systems and Local code for external Hydran systems	(MIL05A-RFI006)
6	MEC	Domestic hot water generation	Localised electrical heaters shall be provided.	Local sustainability regulations mandate that DHW must be produced with a percentage of renewable energy source. Heat pump with high COP is considered renewable energy.	Localisation
7	MEC	Fire pump arrangement	Fire pump set shall consist of 1 electrical pump (duty) and 1 diesel pump (stand by).	Following NFPA standard (accepted by local regulations) and due to limitation on house power, nos.Two diesel pumps (duty/standby) is an acceptable arrangement that will be implemented. In addition, the use of only disel pumps produces significant economic savings on electrical distribution. Consequently, this variation is to be regarded as value engeneering	Localisation
8	MEC	Fire pump arrangement	The arrangement of fire pumps as per BOD is shared between hydrant and sprinkler.	As per local regulation on hydrant fire fighting system, it shall be provided a dedicated fire pump room for hydrant and another one fire pump room for sprinkler system.	Localisation
9	ARC	Admin Block layout	2 storey Admin Block layout for a two storey 24MW building	Due to Tenant request cointain we have to provide a minumum area for Tenant Storage and Tenant Office related to the total ammount of MW for the building. For this reason the admin block layout has been changed	Tenant Requirement
10	MEC	Drainage pipes material	Ductile Iron pipework for all internal drainage	Common construction practices goes on the HDPE / PVC material for all internal drainage. In Italy is almost never used ductile Iron for internal drainage system.	Localisation
11	ARC	Loading Docks and Service areas	A scissor lift is recessed into the building to allow for unloading from vans and other vehicles differing in height. A ramp shall be provided externally to allow step free access from the low area to high area in the loading docks.	In this project an interior dock levellers recessed is designed into the building due to Tenant request cointened in-Exhibits A2.	Tenant Requirement
12	ARC	Security Standoffs/ACCESS AND SECURITY	Stand-off distances shall be provided as follows: inside - 15m from fence to critical structures.	Due to the size of the lot, it is not possible to maintain the required minimum distance of 15m from the fence to a critical structure in the south-east corner, where the infrastructure is located close to the boundary.	Localisation
13	ELE	MV manhole dimensions	Width provision for spatial planning required is 3.8m (chambers)	MV Manholes sizes have been designed based on specific Project requirement in order to comply with available space.	Localisation

PROJECT STEER DEVIATION LOG
Project Reference: MIL08A

Devaiations applicable to STEER Design Document - STEER-BWE-XX-XX-RP-N-00004 - STACK BOD V P01 - Stack EMEA European Reference Design (Steer)

Number	Disipline	Subject	Steer Design - BOD	Deviation from Steer Design	Reason for deviations
14	ELE	OF manhole dimensions	Width provision for spatial planning required is 3.7m (chambers)	OF Manholes sizes have been designed based on specific Project requirement in order to comply with available space.	Localisation
15	Mech	Acceptable RH range within data halls	As per reference design, for data halls and critical electrical rooms, relative humidity shall be kept within a range of 20-80%	This range was relaxed to 5-80% in the SOQ, which shall presumably supersede reference design requirements.	Tenant Requirement
16	Mech	Humidification	FAHUs serving data halls and critical spaces shall be provided with humidifiers	As per revised humidification calculations based on a relaxed RH range of 5-80%, worst case ambient conditions in terms of moisture content/RH% fall within the acceptable range of rack inlet air conditions.	Value Engineering related to Point 19, where the tenant is requesting a wide humidity range.
17	ARC	Separate MMR & POE rooms	POE & MMR room shall be combined.	As requested by Stack, separate MMR and POE rooms were provided	Stack request - discussion during RIBA2
18	MEP	Data hall service clearance	2.8m clear space within the whitespace indicated in sheet STEER-BWE-DC-00-DR-N-60204 Typical Data Hall and as per BOD Stack decision	3.8m clear space in height within the whitespace (data hall) required by SOQ	Tenant Requirement
19	ELE	Corridor service section	Electrical zone kept at the left and mech zone at the other side.	Accomplish as much as possible due to additional Tenant's requirements (e.g. Tenant Telecom Secure Trunking route, etc.).	Tenant Requirement
20	ELE	Small Power Zoning Layout	PCS (Primarly Critical Substation) provides general power for the building.	Due to the significant size of the site, there are not enough reserve loads in the PCS according to the load calculation, so the mechanical PMS substations were used to provide general power to the building.	Localisation
21	ELE	Lighting lux levels	Requirement 2-4-15.1: The light fittings within the premises shall be high frequency fluorescent / LED luminaires. Data halls shall be provided with a minimum of 500 Lux / 50fc @ 36 inches above finished floor (AFF) and the other leased spaces and areas shall be provided with 250 lux / 25fc @ 36 inches AFF. Lighting will be provided for all tenant leased areas inclusive of administration, storage, office, and shredder location. Corridor & Staircases - 100 lux Lobby/ Reception - 250 lux Office - 250 lux Crah corridor - 200 lux Data Hall - 500lx Final Client Spaces - 250 lux	Due to local standard requirements different levels of Lux, so they have been modified accordingly. As per UNI EN 12464-1 Corridor & Staircases - 100 lux Lobby/Reception - 300 lux with UGR 19 Office - 500 lux with UGR 19 CRAH corridor - 250 lux Data Hall - 500lx Final Client Spaces - 250 lux	Localisation/Tenant Requirements
22	ELE	Voice Evacuation System	Sounder Flasher was specified in the BOD.	Due to local standard requirements, EVAC system introduced to notify occupants with an alarm tone followed by a voice instead of the traditional horn	Localisation
23	Mech	Air-cooled chiller technology	Magnetic bearing compressor	Both magnetic bearing and screw options are being assessed, however the electrical design is based on the screw option covering the worst case scenario for the time being until technical and cost assessment is finalized. Both solution have been provided to Stack Supply Chain for evaluation (cost, maintenance and Vendor loacalisation, ...)	Vendor advice - Stack
24	Mech	Data hall/IDF vent system	Data hall & IDF rooms shall be provided with supply and return air ducts, space shall be kept under positive pressure of 12.5Pa to adjacent space.	High positive pressure of 12.5Pa resulted in high leakage rates to surrounding corridors, to avoid over designing the system, return air will be extracted from the surrounding corridors and data halls will be provided with supply air only.	Possibility to take into account VE consideration maintaining functions requested in the BOD
25	Mech	Critical vent system	AHU serving critical spaces shall be sized based on Summer Wet Bulb Temperature (non-critical rooms & data hall pressurization) = ASHRAE 0.4% cooling.	Design “summer” dry bulb: American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) n=20 extreme annual dry bulb temperatures.	Tenant Request

PROJECT STEER DEVIATION LOG
Project Reference: MIL08A

Devaiations applicable to STEER Design Document - STEER-BWE-XX-XX-RP-N-00004 - STACK BOD V P01 - Stack EMEA European Reference Design (Steer)

Number	Disipline	Subject	Steer Design - BOD	Deviation from Steer Design	Reason for deviations
26	ARC	Lift Visibility from SOC	BOD requirements have direct view from SOC to Lifts inside the building	Due to Fire Brigade Code Regulation we have to separate the lifts with a enclosed fire rated lobby. It is also necessary to have 2 different location for lifts due to Tenant Request	Localisation
27	ARC	Lobby with turnstile	BOD requirements indicate 2 turnstile and 1 door to access in to the secure zone of the building.	Due to Tenant Request we have to provide 3 doors with controlled system instead of turnstile.	Tenant Requirements
28	ARC	Emergency Management Room	Emergency Management Room to be adjacent the SOC as per BOD	SOC is not controlled by Stack so for Fire Brigade Code Regulation the Emergency Management Room has to be manned 24/7 and accessible from a protected path, so for this reason we move this room in another location. As per this regulation, the room will also house the fire alarm panel and EPO control. BOD indicates the fire alarm panel to be at the SOC.	Localisation/Tenant Requirements
29	ARC	Data Hall Wall partitions	WALL TYPE 5 - ADAPTABLE WALL - WHITEWALL PLASTERBOARD OR BLOCKWORK APPLICATION:BACK OF HOUSE GF SPAN: SLAB TO SLAB	For all the data hall rooms we have to guaranted a fire rated compartment of 1 hour and due to the shape of the structural slab with double T beam we have to use a gypsum wall in order to have a fire certification tested with this structural system.	(MIL05A-RFI004)
30	ARC	Ceilings for storage	In Steer Design drawings we have all storages in the admin block with ceiling	Due to optimize quantity of sprinklers and smoke detection system we provide all the storage without ceilings	(MIL05A-RFI004)
31	ARC	Office doors	Office: 2.4 m painted solid core wood doors in an interior painted storefront system.	Due to Fire Brigade Code Regulation we have to provide most of the doors in the admin block with the fire rated 1h and smoke protection, so we decide to use metal doors also in the admin block to better allign with this requirement.	(MIL05A-RFI004)
32	ARC	Perimeter Wall	BOD foresees just fence as perimeter wall	The perimeter wall will be constructed in continuity with the rest of the MIL04 campus.	(MIL05A-RFI004)
33	MEP	Phase Strategy	MEP phasing diagram - Appendix ZD of BOD	Phasing tailored to project requirement adopted , refer to the design phasing drawings	
34	MEP	SCR	BOD requires Generators to be without Selective Catalytic Reduction	No SCR system required , only space provision is allocated as agreed with Stack.	Localisation
35	ARC	Facade Material	BOD requires white facade with composit panel	The facades will be constructed in continuity with the other buildings of the MIL04 campus, as approved by the "Sopraintendenza"	Localisation
36	ARC	Environmental mitigation	No specific request on this topic	Various environmental mitigation measures are required in the municipality's regulations	Localisation
37	ARC	Internal Layout	Refer to steer design CSA drawings on internal layout	The internal layout of the building, in particular the admin block, was revised to meet the localisation requirements.	Localisation
38	ARC	Internal Layout	Refer to steer design CSA drawings on internal layout	The internal layout of the building, in particular the admin block, was revised to meet tenant requirements. E.g. loading bay and reaciving area layout with storage, office and storage standard based on sqm/MW ratio, etc	Tenant Requirements
39	ARC	Internal Layout	Refer to steer design CSA drawings on internal layout	The internal layout of the building, in particular the admin block, was revised to meet Stack requirements. E.g. maintenance storage, etc	(MIL05A-RFI004)
40	ARC	Internal Finishes	Steer design provide resin epoxy finish for all Data Hall part of the building, both DH rooms, IDF, corridors, MEP gallery and Storages (see APPENDIX O – FINISHES).	Due to lthe ast input recieved from Stack, we will provide epoxy resin finish only for the Data Hall rooms and IDF rooms. Therefore, in the project L22 suggest using floor antidust on concrete slab for all the corridors inside the Data Hall block, MEP Gallery, Loading Bay, Technical Rooms and Storages of the building.	(MIL05A-RFI004)
41	Mech	Buffer Vessels control valves	3-Way Control Valves are proposed	As per local market assessment , DN250 3-Way valves are not widely available and with a significant cost uplift , accordingly 2-Way valves are proposed for this project, some of which will be PICV type as required for enhanced control, noting no impact on modes of operation.	Localisation

PROJECT STEER DEVIATION LOG
Project Reference: MIL08A

Devaiations applicable to STEER Design Document - STEER-BWE-XX-XX-RP-N-00004 - STACK BOD V P01 - Stack EMEA European Reference Design (Steer)

Number	Disipline	Subject	Steer Design - BOD	Deviation from Steer Design	Reason for deviations
42	ELE	Earthing System	1. Generator earth bar either connected earth bar to earth bar or connected to a ring as per STEER-BWE-ZZ-XX-SD-E-69101 schematic. 2. 6nos. of data hall secondary bonding bar and each has dedicated loop to 2-separate primary bonding bar.	1. Difference in equipment layout resulted in variation of equipotential bonding strategy, wherein the generator earth bars are now connected to the soil mesh, at the point closest to the equipment. 2. The SOQ requires 1-bar every 3 row resulting to 9 to 12 number of bars in a data hall which is an increase from the BOD. In order to rationalise the quantity of cables, EN 50310 standard has been implemented allowing bonding bars for a localised area to be looped together and routed back to one primary bonding bar only.	Localisation/ Tenant Requirements
43	ELE	Roof Lightning Protection	Roof 5x5m mesh and lightning rods.	Lightning rods employing rolling sphere method in coordination with local requirements and lightning protection manufacturer.	Localisation
44	ELE	EPO	Not indicated	It is in Italian regulation to include an emergency power off (EPO) system algined with the Fire Brigade requirements.	Localisation
45	ELE	Photovoltaic system	Where required, PVs shall be located at gantry level and at roof level above the chiller plant.	PVs provided in the parking canopies also in order to comply with local regulations.	Localisation
46	ELE	MV ducts	1. 250mm + 150mm MV ducts 2. 150mm Fiber ducts	1. 200mm MV ducts - quantity aligned with site capacity. 2. 100mm ER Fiber ducts: sizes and quantity as per SOQ requirement.	Localisation/ Tenant Requirements
47	ARC	Smoke filter with EI ceiling	BOD does not provide any type of ceiling in the corridors and filters near the data halls.	Due to Fire Brigade Code Regulation we have to provide all the safe space and the smoke filters in the building with an EI ceiling fire rated 60 minutes.	Localisation
48	Mech	Admin block ventilation system	Admin block shall be provided with two double decker air handling units (supply & return).	As per fresh air calculations, one air handling unit would be sufficient to provide ventilation requirements within admin building.	VE
49	Mech	Loading bay ventilation system	Loading bay shall be provided with heat recovery unit that consists of recuperator, frost coil and electric heating coil.	Loading bay was provided with DX AHU due to the following reasons: 1. Dehumidification: cooling is needed to temper humidity level in summer; 2. Power saving: DX system is 3 times more efficient than electrical heating coil.	Localisation
50	Mech	PODs / Switchrooms vent system	Fresh air and extract air provisions shall be branched from data hall air handling units to feed switchroom.	Given that power modules will be installed in phases, each power module (LV and MV section) shall be provided with standalone ventilation system with heat recovery. Packaged ventilation system shall be provided by Vendor	Localisation "Phasing strategy & constructability" - RFI001
51	Mech	Urea system	Day urea tanks within generator containers shall be fed by a central urea system that consists of N+1 bulk storage tanks,redundant pumping system and distribution ring.	Given the proposed phasing strategy, each container was provided with a space provision for a separate urea storage tank that is meant to be filled via localised fuel and urea filling cabinets.	
52	Elec	IDF Rooms	As per BOD phasing layouts, two IDFs only shall be deployed at phase-01.	As per Journey's requirements, four IDF rooms shall be ready to service at day-01, therefore, IDF rows were positioned either side of data halls 1&2 as shown on layouts.	Tenant Requirements
53	Elec	STSs	One STS expected for each IT UPS to Data Hall feeder.	Reduced to 4no. STS for 4no. data hall busbar feeders due to the L-L SOQ requirements. This was further reduced to 2no. STS per primary IT block.	VE / L2L SOQ
54	Elec	Secondary MV Rooms	As per BOD, provision of 2no. secondary MV rooms within the admin block.	Due to local requirements, having secondary MV rooms within the building will require and EMF study. Therefore, this was to save on cost associated with EMF studies and associated provision i.e. faraday cage.	VE/Localisation
55	Arc	Admin block rainwater drainage	STEER Design: BOD: No roof drains or leaders shall be located over the data centre. Roof pitch to drain to external scuppers and downspouts through parapets.	Option 2) Downspouts on the long side of the building. • This solution would require a roof slope of only 40 cm, having a smaller impact on the usable space for installations. • The water flow path, at around 18 meters, would be shorter and safer.	Rainwater Drainage - Admin Block 1. The curtain wall façade windows does not allow for the installation of downspouts on the main facade. As illustrated in the render in the BOD, no downspouts are foreseen on this facade, and their addition would significantly affect the building's aesthetics. 2. The narrow and elongated configuration of the Admin block. 3. According to the BOD: No roof drains or leaders shall be located over the data centre. Roof pitch to drain to external scuppers and downspouts through parapets.
56	Elec	Power Module CRAH Units	As per BOD, power module CRAH units served from Mail LV switchboard. Not UPS backed.	These power supplies have been moved to the MUPS board in order to have UPS backup.	Tenant Requirements

APPENDIX E – RIBA STAGE 4 REQUIRED DELIVERABLES

01 This Appendix includes the typical Stage 4 deliverables list for Stack. This is provided for reference only; the final deliverables list shall be as per further agreement with Stack.

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Task Information Delivery Plan (TIDP)

Client	STACK - Typical Stage 4 Deliverables
Project Number	
Project Title	
Task Team Role	
Date Created	
TIDP Version	
Document Reference	
Suitability	

DOCUMENT REFERENCE	DESCRIPTION	SCALE
BUILDING INFORMATION MODELLING		
	BIM Model Trasmission Document	
	BEP - BIM Execution Plan	
	ANN01_LOD Matrix	
	ANN02_BIM MANAGEMENT	
	ANN03_WBS03 RIBA4	
	ANN04_Document Naming Convention	
	ANN05_Risk Register	
	Project Directory	
BIM Model File - RVT Format		
Generic Models		
	Federated BIM Model	
Artchitectural Models		
	Main Building	
	Project Site Model	
	Survey Site Model	
Mechanical Models		
	Main Building	
	Site Mechanical	
Electrical Models		
	Main Building	
	Site Electrical	
Structural Models		
	Main Building	
	Site Structural	
BIM Model File - IFC Format		
Artchitectural Models		
	Main Building	
	Project Site Model	
	Survey Site Model	
Mechanical Models		
	Main Building	
	Site Mechanical	
Electrical Models		
	Main Building	
	Site Electrical	
Structural Models		
	Main Building	
	Site Structural	
MEP		
REGISTER		
	BWE Master Information Delivery Plan (MIDP)	N/A
	BWE Task Information Delivery Plan (TIDP)	N/A
MODELS		
	Building A MEP Model	N/A
MECHANICAL DRAWINGS		
50 Series - Environmental Treatment		
	Mechanical Services, General Notes	NTS
	Mechanical Services, Details	NTS
	Public Health Services, Details	NTS

Task Information Delivery Plan (TIDP)

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Project Number	
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DOCUMENT REFERENCE	DESCRIPTION	SCALE
	Fire Protection Services, Details	NTS
51Series - BMS/EPMS		
	Indicative Sensor Location Layout Level 00 Overview	1:200
	Indicative Sensor Location Layout Level 00 Sheet 1	1:100
	Indicative Sensor Location Layout Level 00 Sheet 2	1:100
	Indicative Sensor Location Layout Level 00 Sheet 3	1:100
	Indicative Sensor Location Layout Level 00 Sheet 4	1:100
	Indicative Sensor Location Layout Level 01 Overview	1:250
	Indicative Sensor Location Layout Roof Level Overview	1:200
	Indicative Sensor Location Layout Roof Level Sheet 1	1:100
	Indicative Sensor Location Layout Roof Level Sheet 2	1:100
	Indicative Sensor Location Layout Roof Level Sheet 3	1:100
	Indicative Sensor Location Layout Roof Level Sheet 4	1:100
	Indicative sensor location Layout Admin Block, Multiple Levels	1:100
	Indicative sensor location Layout Admin Block, Level 01	1:100
	BMS Schematic	N.T.S
	EPMS Schematic	N.T.S
	Leak Detection Schematic	N.T.S
	Leak Detection Zoning Layout Level 00 Overview	1:250
	Leak Detection Layout Level 00 Overview	1:200
	Leak Detection Layout Level 00 Sheet 1	1:100
	Leak Detection Layout Level 00 Sheet 2	1:100
	Leak Detection Layout Level 00 Sheet 3	1:100
	Leak Detection Layout Level 00 Sheet 4	1:100
	Leak Detection Zoning Layout Roof Level Overview	1:250
	Leak Detection Layout Roof Level Overview	1:200
	Leak Detection Layout Roof Sheet 1	1:100
	Leak Detection Layout Roof Sheet 2	1:100
	Leak Detection Layout Roof Sheet 3	1:100
	Leak Detection Layout Roof Sheet 4	1:100
	Leak Detection layout Admin Block, Multiple Levels	1:100
52 Series - DRAINAGE		
	Drainage Schematic Sheet 1	N.T.S
	Drainage Schematic Sheet 2	N.T.S
	Condensate Drain Pipe Schematic	N.T.S
	Drainage Layout Level 00 Overview	1:200
	Drainage Layout Level 00 Sheet 1	1:100
	Drainage Layout Level 00 Sheet 2	1:100
	Drainage Layout Level 00 Sheet 3	1:100
	Drainage Layout Level 00 Sheet 4	1:100
	Drainage Layout Roof Level Overview	1:200
	Drainage Layout Roof Level Sheet 1	1:100
	Drainage Layout Roof Level Sheet 2	1:100
	Drainage Layout Roof Level Sheet 3	1:100
	Drainage Layout Roof Level Sheet 4	1:100
	Drainage Layout, Admin Block, Multiple levels	1:100
53 Series - DOMESTIC WATER		
	Water Supply Schematic Sheet 1	N.T.S
	Water Supply Schematic Sheet 2	N.T.S.
	Water Supply Layout Level 00 Overview	1:200
	Water Supply Layout Level 00 Sheet 1	1:100
	Water Supply Layout Level 00 Sheet 2	1:100
	Water Supply Layout Level 00 Sheet 3	1:100
	Water Supply Layout Level 00 Sheet 4	1:100
	Water Supply Layout Roof Level Overview	1:200
	Water Supply Layout Roof Level Sheet 1	1:100
	Water Supply Layout Roof Level Sheet 2	1:100

Task Information Delivery Plan (TIDP)

Client	STACK - Typical Stage 4 Deliverables
Project Number	
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Suitability	

DOCUMENT REFERENCE	DESCRIPTION	SCALE
	Water Supply Layout Roof Level Sheet 3	1:100
	Water Supply Layout Roof Level Sheet 4	1:100
	Water Supply Layout, Admin Block, Multiple levels	1:100
54 Series - FUEL		
	Typical Fuel Schematic IT & Mech Generators (3000kVA)	N.T.S
	Fuel Layout Level 00 Overview	1:200
	Fuel Layout Level 00 Sheet 1	1:100
	Fuel Layout Level 00 Sheet 2	1:100
	Fuel Layout Level 00 Sheet 3	1:100
	Fuel Layout Level 00 Sheet 4	1:100
55 Series - COOLING		
	Critical Cooling Schematic Sheet 1	N.T.S
	Critical Cooling Schematic Sheet 2	N.T.S
	Buffer Vessels Mode of Operations	N.T.S
	Cooling & Heating Schematic	N.T.S
	Critical Cooling Layout Level 00 Overview	1:200
	Critical Cooling Layout Level 00 Sheet 1	1:100
	Critical Cooling Layout Level 00 Sheet 2	1:100
	Critical Cooling Layout Level 00 Sheet 3	1:100
	Critical Cooling Layout Level 00 Sheet 4	1:100
	Critical Cooling Layout Roof Level Overview	1:200
	Critical Cooling Layout Roof Level Sheet 1	1:100
	Critical Cooling Layout Roof Level Sheet 2	1:100
	Critical Cooling Layout Roof Level Sheet 3	1:100
	Critical Cooling Layout Roof Level Sheet 4	1:100
	Cooling & Heating Layout, Admin Block, Multiple levels	1:100
57 Series - VENTILATION		
	Typical Ventilation Schematic - DH Building	N.T.S
	Typical Ventilation Schematic - Smoke System	N.T.S
	Ventilation Schematic - Admin Block	N.T.S
	Ventilation Layout Level 00 Overview	1:200
	Ventilation Layout Level 00 Sheet 1	1:100
	Ventilation Layout Level 00 Sheet 2	1:100
	Ventilation Layout Level 00 Sheet 3	1:100
	Ventilation Layout Level 00 Sheet 4	1:100
	Ventilation Layout - Level 01	1:200
	Ventilation Layout - Roof Level Overview	1:200
	Ventilation Layout - Roof Level sheet 1	1:100
	Ventilation Layout - Roof Level sheet 2	1:100
	Ventilation Layout - Roof Level sheet 3	1:100
	Ventilation Layout - Roof Level sheet 4	1:100
	Ventilation Layout, Admin Block, Multiple levels	1:100
58 Series - FIRE FIGHTING		
	Fire Suppression Schematic Sheet 1	N.T.S
	Fire Suppression Schematic Sheet 2	N.T.S
	Fire Protection Zoning Layout - Level 00	1:200
	Fire Protection Zoning Layout - Level 01	1:200
	Fire Protection Zoning Layout - Roof Level	1:200
	Fire Protection Layout Level 00 Overview	1:200
	Fire Protection Layout Level 00 Sheet 1	1:100
	Fire Protection Layout Level 00 Sheet 2	1:100
	Fire Protection Layout Level 00 Sheet 3	1:100
	Fire Protection Layout Level 00 Sheet 4	1:100
	Fire Protection Layout Roof Level Overview	1:200
	Fire Protection Layout Roof Level Sheet 1	1:100
	Fire Protection Layout Roof Level Sheet 2	1:100
	Fire Protection Layout Roof Level Sheet 3	1:100

Task Information Delivery Plan (TIDP)

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Project Number	
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DOCUMENT REFERENCE	DESCRIPTION	SCALE
	Fire Protection Layout Roof Level Sheet 4	1:100
	Fire Protection Layout, Admin Block, Multiple levels	1:100
ELECTRICAL DRAWINGS		
SERIES 60 - ELECTRICAL GENERAL		
	Data Hall Power Striping Layout - Level 00 Overview	1:200
	Photovoltaic Panel Layout Overview	1:200
	Typical Containment Detail, Sheet 1	
	Typical Containment Detail, Sheet 2	
	Typical Mounting Elevation of Electrical Services	
SERIES 61 - MV and LV SLD		
	MV Schematics Overview	N.T.S
	LV Schematics - Typical Critical System Overview	N.T.S
	LV Schematics - Typical Primary Critical System	N.T.S
	LV Schematics - Typical Reserve Critical System	N.T.S
	LV Schematics - Typical Mechanical System Overview	N.T.S
	LV Schematics - Primary Mechanical System V	N.T.S
	LV Schematics - Primary Mechanical System W	N.T.S
	LV Schematics - Primary Mechanical System X	N.T.S
	LV Schematics - Primary Mechanical System Y	NTS
	LV Schematics - Primary Mechanical System Z	NTS
SERIES 61 - CONTAINMENT		
	Containment Layout - Level 00 Overview	1:200
	Containment Layout - Level 00, Sheet 1	1:100
	Containment Layout - Level 00, Sheet 2	1:100
	Containment Layout - Level 00, Sheet 3	1:100
	Containment Layout - Level 00, Sheet 4	1:100
	Containment Layout - Roof Level Overview	1:200
	Containment Layout - Roof Level, Sheet 1	1:100
	Containment Layout - Roof Level, Sheet 2	1:100
	Containment Layout - Roof Level, Sheet 3	1:100
	Containment Layout - Roof Level, Sheet 4	1:100
	SP & ELV Containment Layout - Level 00 Overview	1:200
	SP & ELV Containment Layout - Level 00, Sheet 1	1:100
	SP & ELV Containment Layout - Level 00, Sheet 2	1:100
	SP & ELV Containment Layout - Level 00, Sheet 3	1:100
	SP & ELV Containment Layout - Level 00, Sheet 4	1:100
	SP & ELV Containment Layout - Roof Level Overview	1:200
	SP & ELV Containment Layout - Roof Level, Sheet 1	1:100
	SP & ELV Containment Layout - Roof Level, Sheet 2	1:100
	SP & ELV Containment Layout - Roof Level, Sheet 3	1:100
	SP & ELV Containment Layout - Roof Level, Sheet 4	1:100
	Busbar Layout - Level 00 Overview	1:200
	Busbar Layout - Level 00, Sheet 1	1:100
	Busbar Layout - Level 00, Sheet 2	1:100
	Busbar Layout - Level 00, Sheet 3	1:100
	Busbar Layout - Level 00, Sheet 4	1:100
	Containment Layout Admin Block, Multiple levels	1:100
	SP & ELV Containment Layout Admin Block, Multiple levels	
SERIES 62 - SMALL POWER		
	Sitewide Small Power Layout - Overview	1:250
	Small Power Zoning - Level 00 Overview	1:200
	Small Power Zoning - Admin Block, Level 01	1:200
	Small Power Zoning - Roof Level Overview	1:200
	Small Power Layout, Level 00, Overview	1:200
	Small Power Layout, Level 00, Sheet 1	1:100
	Small Power Layout, Level 00, Sheet 2	1:100
	Small Power Layout, Level 00, Sheet 3	1:100
	Small Power Layout, Level 00, Sheet 4	1:100
	Small Power Layout, Roof Level, Overview	1:200

Task Information Delivery Plan (TIDP)

Client	STACK - Typical Stage 4 Deliverables
Project Number	
Project Title	
Task Team Role	
Date Created	
TIDP Version	
Document Reference	
Suitability	

DOCUMENT REFERENCE	DESCRIPTION	SCALE
	Small Power Layout, Roof Level, Sheet 1	1:100
	Small Power Layout, Roof Level, Sheet 2	1:100
	Small Power Layout, Roof Level, Sheet 3	1:100
	Small Power Layout, Roof Level, Sheet 4	1:100
	Small Power Layout Admin Block, Multiple levels	1:100
SERIES 63 - LIGHTING		
	Lighting Control Overview Schematic	N.T.S
	Emergency Lighting Schematic	N.T.S
	Lighting Layout, Level 00, Overview	1:200
	Lighting Layout, Level 00, Sheet 1	1:100
	Lighting Layout, Level 00, Sheet 2	1:100
	Lighting Layout, Level 00, Sheet 3	1:100
	Lighting Layout, Level 00, Sheet 4	1:100
	Lighting Layout, Roof Level, Overview	1:200
	Lighting Layout, Roof Level, Sheet 1	1:100
	Lighting Layout, Roof Level, Sheet 2	1:100
	Lighting Layout, Roof Level, Sheet 3	1:100
	Lighting Layout, Roof Level, Sheet 4	1:100
	Sitewide Lighting Layout, Overview	1:500
	Lighting Layout Admin Block, Multiple levels	1:100
SERIES 65 - TELECOMS		
	Telecoms Schematics	N.T.S
	Telecoms Pathways Level 00 Overview	1:200
	Telecoms Pathways Level 01 Overview	1:100
	Landlord Network Schematics	
	Data Point Layout Level 00 Overview	1:200
	Data Point Layout Level 00 Sheet 1	1:100
	Data Point Layout Level 00 Sheet 2	1:100
	Data Point Layout Level 00 Sheet 3	1:100
	Data Point Layout Level 00 Sheet 4	1:100
	Data Point Layout Roof Level Overview	1:200
	Data Point Layout Roof Level Sheet 1	1:100
	Data Point Layout Roof Level Sheet 2	1:100
	Data Point Layout Roof Level Sheet 3	1:100
	Data Point Layout Roof Level Sheet 4	1:100
	Data Point layout Admin Block, Multiple Levels	1:100
	Sitewide Data Point Layout, Overview	1:500
SERIES 67 - SECURITY		
	Security Functional Schematic	N.T.S
	Security Layout Level 00 Overview	1:200
	Security Layout Level 00 Sheet 1	1:100
	Security Layout Level 00 Sheet 2	1:100
	Security Layout Level 00 Sheet 3	1:100
	Security Layout Level 00 Sheet 4	1:100
	Security Layout Roof level Overview	1:200
	Security Layout Roof level Sheet 1	1:100
	Security Layout Roof level Sheet 2	1:100
	Security Layout Roof level Sheet 3	1:100
	Security Layout Roof level Sheet 4	1:100
	Security Layout Admin Block, Multiple Levels	
	Sitewide Security Layout, Overview	1:250
	Typical Fire Alarm Schematic	1:200
	Fire Alarm Zoning Level 00 Overview	1:250
	Fire Alarm Layout Level 00 Overview	1:200

Task Information Delivery Plan (TIDP)

Client	STACK - Typical Stage 4 Deliverables
Project Number	
Project Title	
Task Team Role	
Date Created	
TIDP Version	
Document Reference	
Suitability	

DOCUMENT REFERENCE	DESCRIPTION	SCALE
	Fire Alarm Layout Level 00 Sheet 1	1:100
	Fire Alarm Layout Level 00 Sheet 2	1:100
	Fire Alarm Layout Level 00 Sheet 3	1:100
	Fire Alarm Layout Level 00 Sheet 4	1:100
	Fire Alarm Ceiling Void Layout Level 00 Overview	1:200
	Fire Alarm Ceiling Void Layout Level 00 Sheet 1	1:100
	Fire Alarm Ceiling Void Layout Level 00 Sheet 2	1:100
	Fire Alarm Ceiling Void Layout Level 00 Sheet 3	1:100
	Fire Alarm Ceiling Void Layout Level 00 Sheet 4	1:100
	Fire Alarm Zoning Admin Block, Level 01	1:250
	Fire Alarm Zoning Roof Level Overview	1:250
	Fire Alarm Layout Roof Level Overview	1:200
	Fire Alarm Layout Roof Level Sheet 1	1:100
	Fire Alarm Layout Roof Level Sheet 2	1:100
	Fire Alarm Layout Roof Level Sheet 3	1:100
	Fire Alarm Layout Roof Level Sheet 4	1:100
	Fire Alarm Layout Admin Block, Multiple Levels	1:100
	Fire Alarm Void Detectors Layout Admin Block, Multiple Levels	1:100
	Sitewide Fire Alarm Layout, Overview	1:500
SERIES 69 - EARTHING & LIGHTNING PROTECTION		
	Earthing Schematic Sheet 1	NTS
	Earthing Schematic Sheet 2	NTS
	Telecoms Earthing Schematic	NTS
	Earthing & Lightning Protection Layout, Level 00, Overview	1:200
	Earthing & Lightning Protection Layout, Roof Level, Overview	1:200
	Earthing & Lightning Protection, Admin Block, Level 01	1:100
	Sitewide Earthing & Lightning Protection Layout, Overview	1:200
COMBINED MEP DRAWINGS		
	MEP Primary Plant Layout Level 00 Overview	1:200
	MEP Primary Plant Layout, Admin Block, Level 01	1:100
	MEP Primary Plant Layout Roof Level Overview	1:500
	Typical 6MW Data Hall Layout	1:100
	Typical 4MW Data Hall Layout	1:50
	Typical Switchroom Layout	1:50
	Typical MMR & ER Room Layout	1:50
	MEP Services Layout, External Rooms	1:50
	Plant Replacement Layout, Level 00	1:200
	Plant Replacement Layout, Roof Level	1:200
	MEP Phasing Layout, Level 00	1:200
	MEP Phasing Layout, Admin Block, Level 01	1:200
	MEP Phasing Layout, Roof Level	1:200
	MEP Services , Typical Sections	NTS
	Plant Room 3D View - Chiller Gantry, Ancillary Rooms	NTS
	Plant Room 3D View - Fire Pump Room, Domestic Water Pump Room, Valve Room	NTS
	MEP Builders Work Level 00	1:200
	MEP Builders Work Level 01	1:200
	MEP Builders Work Roof Level	1:200
MEP DOCUMENTS		
CALCULATIONS		
	Break Tank Sizing	N/A
	Domestic Booster Pump Sizing	N/A
	Hot Water Circulating Pump Sizing	N/A

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Project Number	
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TIDP Version	
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DOCUMENT REFERENCE	DESCRIPTION	SCALE
	Water Pipe Sizing	N/A
	Hot Water Heater Sizing	N/A
	Drainage Flow Rate	N/A
	Fuel & Urea Storage Calculations	N/A
	Air Curtain Calculations	N/A
	Buffer Vessel Sizing	N/A
	CHW Pump Head Calculation	N/A
	Technology water pump head calculation	N/A
	System expansion and pressurisation calculation	N/A
	Admin Building Cooling and Heating Load Calculation	N/A
	Critical Area Cooling and Heating Load Calculation	N/A
	Technology Water Pipe Sizing	N/A
	Facility Chilled Water Pipe Sizing	N/A
	CHW System Volume	N/A
	TW System Volume	N/A
	Room Datasheet	N/A
	Ventilation Calculation	N/A
	Air Balance	N/A
	Psychrometric Calculation	N/A
	Pressure Drop Calculation	N/A
	Room Pressurization	N/A
	Fire Water Tank Calculation	N/A
	Hydraulic Sprinkler Pump Calculations	N/A
	Hydraulic Hydrant Pump Calculations	N/A
	Electrical Load Schedule	N/A
	MV/LV Cable Calculations (Trimble/Amtech or equivalent)	N/A
	Lighting Calculations (DiaLux or Equivalent)	N/A
	LV Cable Calculations (Trimble/Amtech or equivalent)	N/A
	Load Flow Study (ETAP or Equivalent)	N/A
	Short Circuit Study (ETAP or Equivalent)	N/A
	Selectivity Study (ETAP or Equivalent)	N/A
	Arc Flash Study (ETAP or Equivalent)	N/A
REPORTS		
	Fire Alarm Cause and Effect Matrix	N/A
	Preliminary External CFD Report	N/A
	Preliminary Internal CFD Report	N/A
	Electrical SOO	N/A
	Peak and Annualised PUE Calculation Report	N/A
	Fault Current at Rack Report	N/A
SCHEDULES / DATA SHEET		
	BACS Points List	N/A
	Water Tank Schedule	N/A
	PH Pumps Schedule	N/A
	Water Heater Schedule	N/A
	Water Treatment Schedule - Water Softener	N/A
	Water Treatment Schedule - Water Filter	N/A
	Buffer Vessels	N/A
	MMR CRAH	N/A
	VRF System	N/A
	Pressurization Units and Expansion Vessels	N/A
	Vacuum Degasser Main Network & Technology Water	N/A
	Overdoor Heater	N/A

Task Information Delivery Plan (TIDP)

Client	STACK - Typical Stage 4 Deliverables
Project Number	
Project Title	
Task Team Role	
Date Created	
TIDP Version	
Document Reference	
Suitability	

DOCUMENT REFERENCE	DESCRIPTION	SCALE
	Room Heater	N/A
	Air Handling Units	N/A
	Heat Recovery Unit	N/A
	Fan Schedule	N/A
	Air Terminal	N/A
	Attenuators	N/A
	Louvers	N/A
	Overpressure Damper	N/A
	Fire Protection Pumps	N/A
	Air Compressor and Nitrogen Generator	N/A
	Fire Protection Tanks	N/A
	Cable Schedule (MV/LV)	N/A
	Luminaire Schedule	N/A
	Distribution Board Schedules	N/A
	Camera Schedule	N/A
SPECIFICATIONS		
	OFCI Specifications - Air Cooled Chillers	N/A
	OFCI Specifications - Fan Wall Units	N/A
	OFCI Specifications - Cooling Distribution Units	N/A
	OFCI Specifications - Power Modules	N/A
	OFCI Specifications - Generators	N/A
	BMS Specifications	N/A
	Technical Specifications	N/A
	Annex 00 Elect Services for Mech Equip	N/A
	Technical Specifications - Air Cooled Chillers	N/A
	Technical Specifications - Fan Wall Unit	N/A
	Technical Specifications - Cooling Distribution Un'it	N/A
	Annex 04 - Air Handling Unit Specifications	N/A
	Annex 05 - Fan Specifications	N/A
	Annex 06 - Ductwork & Air Distribution	N/A
	Annex 07 - Grilles Diffusers and Louvres	N/A
	Annex 08 - Pipework, fittings and ancillaries	N/A
	Annex 09 - Thermal insulation	N/A
	Annex 10 - Potable and non potable water storage tanks	N/A
	Annex 11 - Thermal buffer vessel	N/A
	Annex 12 - Heating/cooling units for non critical spaces	N/A
	Annex 13 - VRF systems and monosplit	N/A
	Annex 14 - Pumps for building services	N/A
	Annex 15 - Pressurization unit	N/A
	Annex 16 - Water treatment	N/A
	Annex 17 – DCW and DHW fittings and ancillaries	N/A
	Annex 18 – Containment tanks	N/A
	Annex 19 – Fire protection system	N/A
	Annex 20 – Soil, wastewater and condensation pipings	N/A
	Annex 21 – Irrigation system	N/A
	Annex 22 – Other accessory specifications	N/A
	Annex 23 - Noise & Vibration Control	N/A
	Technical Specifications - BMS	N/A
ARCHITECTURE		
REGISTER		
MODEL		
	Architectural - Building Model	N/A
	Architectural - Context model	N/A
	Architectural - Site Model	N/A
	Fire safety building model	N/A
DRAWINGS		
GENERAL		

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DOCUMENT REFERENCE	DESCRIPTION	SCALE
	General Plan and urban section_Existing Condition	1:500
	General Plan and urban section_Comparison	1:500
	General Plan and urban section_Project Status	1:500
	Access Plan and internal circulation	1:500
	Plan of outdoor areas and details	1:1000/1:100/1:10
	Details of outdoor elements	1:100/1:50/1:20
	Outdoor cabins and details	1:1000/1:100/1:50
	Outdoor cabins and details - Prefabricated	1:1000/1:100/1:50
	External roads and details	1:500/1:200
	Outdoor green areas project	1:500
	GF Plan_Office-Data Hall	1:200
	1F Plan_Office	1:200
	Roof Plan_Office-Data Hall	1:200
	GF Plan_Office Plan	1:100
	1F Plan_Office Plan	1:100
	Roof Plan_Office Plan	1:100
	Bathrooms GF	1:50
	Bathrooms 1F	1:50
	Sections	1:200
	Sections Office	1:100
	Elevations	1:200
	Elevations Office	1:100
	Walls_GF Plan	1:200
	Walls_1F Plan	1:200
	Door/Window_GF Plan	1:200
	Door/Window_1F Plan	1:200
	Floors_GF Plan	1:200
	Floors_1F Plan	1:200
	Floors_Roof Plan	1:200
	Ceilings_GF Plan	1:200
	Ceilings_1F Plan	1:200
	Finishes and skirtings_GF Plan	1:200
	Finishes and skirtings_1F/Roof Plan	1:200
	Wall Sections	1:20
	GF Plan_Data Hall	1:100
	Roof Plan_Data Hall	1:100
	Section_Data Hall	1:100
	Roof Plan Details	1:10
	Dogbox Details	1:10
	Gantry Fence	1:25
	Stairs and Railings Details	1:50/1:20
	Facade Nodes Details	1:10
	Windows Details	1:10
	Drywall Nodes Details	1:10
	Ceilings Details	1:10
	Ceilings_GF Plan_Data Hall	1:100
	Details of HAC	1:10
	Wall Abacus	1:20
	Door Abacus_MD/WD	1:20
	Door-Window Abacus_GD-GT-WI	1:20
	Floor Abacus	1:20
	Ceiling Abacus	1:20

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Client	STACK - Typical Stage 4 Deliverables
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TIDP Version	
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DOCUMENT REFERENCE	DESCRIPTION	SCALE
DOCUMENTS		
	Technical Specifications	N/A
	Technical Report	N/A
	Environmental Acoustic Impact Assessment	N/A
STRUCTURE & CIVIL		

REGISTER		
MECHANICAL - DRAWINGS		
	Sitewide External Services (Potable&Non-Potable Water System)	1:250
	Sitewide External Services Schematics (Potable&Non-Potable Water System)	-
	Section External Services (Heat Rejection Recovery System)	tbd
	Sitewide External Services (Heat Rejection Recovery System)	1:250
	Sitewide External Services (Soil&Industrial Water Drainage System)	1:250
	Sections External Services (Soil&Industrial Water Drainage System)	tbd
	Sitewide External Services (Rainwater Drainage System)	1:250
	Sections_External Services (Rainwater Drainage System)	tbd
	Sitewide External Services (Oilwater Drainage System)	1:250
	Sections External Services (Oilwater Drainage System)	tbd
	Sitewide External Services (Firefighting System)	1:250
	Sitewide External Services (Fuel System)	1:250
	Sitewide External Services Overall	1:250
MECHANICAL - REPORTS		
	Underground Mechanical System - Technical Specifications	N/A
	Underground Mechanical System - Price Bill of Quantity	N/A
	Underground Mechanical System - Bill of Quantity	N/A
	Underground Mechanical System - Priced List	N/A
	Underground Mechanical System - Technical Report	N/A
	Mechanical System - Technical Specifications	N/A
	Mechanical System - Price Bill of Quantity	N/A
	Mechanical System - Bill of Quantity	N/A
	Mechanical System - Price List	N/A
ELECTRICAL - DRAWINGS		
SERIES 90 - External Services		
	Sitewide External Services - Medium Voltage Construction phases	NTS
	Sitewide External Services - Underground distribution Medium Voltage	1:250
	Sitewide External Services - Underground distribution Medium voltage Sections	tbd
	Sitewide External Services - Underground distribution Fiber Optics Tenant	1:250
	Sitewide External Services - Underground distribution Fiber Optics Stack	1:250
	Sitewide External Services - Underground distribution Earthing System	1:250
	Sitewide External Services - Underground distribution Lighting System	1:250
	Sitewide External Services - Underground distribution LV System	1:250
	Sitewide External Services - Underground distribution ELV System	1:250
------	Sitewide External Services - Underground distribution Security System	1:250
ELECTRICAL - REPORTS		
	Underground Electrical System - Technical Specifications	N/A
	Underground Electrical System - Price Bill of Quantity	N/A
	Underground Electrical System - Bill of Quantity	N/A
	Underground Electrical System - Priced List	N/A
	Underground Electrical System - Technical Report	N/A
	Electrical and Special System - Technical Specifications	N/A
	Electrical and Special System - Price Bill of Quantity	N/A
	Electrical and Special System - Bill of Quantity	N/A
	Electrical and Special System - Priced List	N/A
STRUCTURAL - DRAWINGS		
	Design Load Plans	1:500
	Excavation plan	1:100-1:200
	Foundation plan	1:200
	Ground floor plan	1:200

Task Information Delivery Plan (TIDP)

Client	**STACK - Typical Stage 4 Deliverables**
Project Number	
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Task Team Role	
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TIDP Version	
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DOCUMENT REFERENCE	DESCRIPTION	SCALE
	First floor plan	1:200
	Roof plan	1:200
	General sections	1:200
	RC cores	1:50
	Typological details	1:10-1:20-1:50
	Formwork and reinforcement foundations	1:20-1:50
	Formwork and reinforcement of panel holder beam	1:20-1:50
	Formwork and reinforcement elevator shaft foundations	1:20-1:50-1:100
	Formwork and reinforcement of stairs and stair's walls and lift's walls	1:20-1:50
	Typological section of fluid viscous dampers,joint cover	1:20
	Stairs reinforcement: typoligical details	1:10
	Ground floor's slab reinforcements	1:20-1:50-1:200
	First floor's slab reinforcements	1:20-1:50-1:200
	Roof's slab reinforcements	1:20-1:50-1:200
	Gantry's steel formwork, typological details	1:20-1:50-1:200
	Gantry's steel bracing formwork, typological details	1:10-1:20-1:50
	Canopy's steel formwork, typological details	1:10-1:50
	Steel formwork of staircase, plan and sections	1:10
	Steel formwork of staircase, typological details	1:10
	Formwork and reinforcement of fence walls/border barriers	1:20
	Structure for MEP Gallery and Data Hall wall: section and typological details	1:10-1:50
	Gantry Roof : plans and sections	1:100
	Steel formwork of technical rooms	1:20-1:50
	Lamination tank Reinforcement plans and sections	1:10-1:50-1:100
	Formwork and reinforcement underground tank	1:20-1:50
	Formwork and reinforcements of FV panels area: plans and sections and typological details	1:10-1:20-1:50-1:200
	Formwork and reinforcement foundations for PV panels	1:20-1:50
	Formwork and reinforcement foundations, elevator shaft	1:20-1:50
	Formwork and reinforcement of Generators slabs	1:20-1:50-1:100
	Steel formwork of fire room and water tank: plan, sections and typical details	1:10-1:50
	General section	1:200
	General plan	1:500
	Basament formwork and reinforcement	1:20-1:50
STRUCTURAL - DOCUMENTS		
	Calculation report	N/A
	Technical specifications	N/A
	Estimative bill of quantities	N/A
	Bill of quantities	N/A
	Works list	N/A
	Prices list	N/A
	Maintenance Plan	N/A

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